The Jetty System.

In the course of a late argument before the Committee on Commerce of the U. S. Senate, on the Galveston Harbor question, Capt. Jas. B. Eads refers to the natural laws involved in the jetty system as follows:

"If the natural laws referred to are clearly understood by the committee, it will have no difficulty in arriving at a correct judgment in the premises. The jetty system is a method of deepening and maintaining a channel across a shoal by such artificial works as shall compel the water flowing over the shoal to pass through a narrower channel. The principles involved in the system may be thus stated in brief:

1st. The current is caused by the fall of the water from a higher to a lower level, which fall is indicated by the slope or inclination of the surface of the water.

2d. The friction of the bed over which the water flows is the chief element or force opposed to the current.

3d. The force of the current will be increased by either increasing the slope of surface, or by increasing the volume of water passing through the channel, or by increasing both.

4th. The friction of the bed controls the velocity of the current just as the application of the brakes to a railway train, going down grade without the aid of the engine, regulates the velocity at which the train moves. The railway brakes and the friction of the bed are to this extent identical in their effect.

5th. The friction increases just as the width of the bed increases. That is to say, if the bed of the channel be twice as great, the friction will be twice as great.

6th. The power of water to transport sand increases with the square of the velocity of the water. That is to say, if the current be made twice as rapid, it will be able to transport four times as much sand."

In the argument, from which the above is quoted, Capt. Eads, in return for the army criticism upon his proposed plan of deepening the channel at Galveston, severely handles the U. S. Engineers. He objects to the great width (twelve thousand feet) between the jetties, as now being constructed; and claims that this plan was adopted, to secure an eighteen foot channel only, at a time when the "dreaded bar-advance" was still firmly believed in by the government engineers; and a rate of annual advance into the Gulf, predicted, for the Mississippi jetties, that would have by this time started them well on their way to Cuba. This bar-advance has *not* taken place at the Southwest Pass, and as according to the latest reports there is no reason to expect a forced extension of the jetties sea-ward for a hundred years to come Capt. Eads makes the most of the false prophesies of the government engineers in this connection.

In further criticising the present Galveston harbor-jetty he says:—

These gentlemen totally overlooked the fact that the friction through such a wide channel would neutralize the effect of the current, an increased force of which must be had to insure the deepening of the channel. Forgetful of the retarding effects of friction on such a channel, they then committed their crowning mistake of leaving enormous lateral outlets near the land, through each jetty, by which the current should be still more enfeebled.

Another equally important principle involved in the jetty system was likewise overlooked by them. I allude to the effect of wave action upon the sandy bottom of the shore of the sea. Neglecting the consideration of this important factor, it is simply impossible to permanently maintain between submerged jetties any increase of depth even if their works could produce it. It is necessary to explain wave action so that the committee will fully understand its bearing upon the question of bar advance, as well as the maintenance of the channel between the jetties.

The waves of the sea produce no continuously horizontal motion whatever in the water over which they are passing, unless the depth be so shallow that the crest of the wave when it sinks will feel the resistance of the bottom. When this occurs a motion of translation or horizontal motion, invariably toward the shore, is induced in the water. Of course, the higher the waves the greater will be the depth at which this horizontal movement will be produced. The waves of the Gulf of Mexico are not high enough to produce this effect sensibly in a greater depth than twenty-five or thirty feet. Waves result from the friction of the wind, and they increase in size in proportion to the "fetch" or distance they are driven under its influence. The fetch in the Gulf of Mexico is limited to about eight hundred miles, and the waves are not, therefore, excessively high. Large waves near the shore are always driven towards the shore, for the reason that a wind blowing off the land cannot create them of any considerable magnitude near it, and because the shallower the water in which the waves are travelling the slower will be their progress; hence, if the waves are moving under an impulse parallel to the shore they will be moving at right angles to that shore and the end of the wave nearest the land will move more slowly because it is in shallower depth. This will cause the waves to come obliquely upon the shore. Hence the horizontal or translatory motion of the water induced by the waves is always towards the land. As they move onwards to the beach, this horizontal motion increases in velocity until under its impulse the water is driven far out on shore.

Under the influence of severe storms the transporting power in the gulf waves is limited to the depth of twenty-five or thirty feet, and increases in strength as they roll into the shallower water; therefore when they rush out upon the beach they are highly charged with sediment; a momentary pause ensues before the retreat of the wave occurs and during this pause the sand is dropped on the shore. As the return current starts from a state of rest it has less power to carry the sand down to the sea than the rapid current had to bring it out upon the shore. In addition to this the retreating current has less volume, because during the momentary pause before the ebb sets in, the volume of the water, which is one of the elements producing the current, becomes much less than it was when coming out on the shore, much of it sinking into the beach, and therefore, the return current, although induced by the steep slope, will be slower and incapable of transporting all of the sand back again.

In this way the sea waves are continually transporting sand shoreward on the sandy beaches of the sea, and where no lateral current exist these beaches continue to grow seaward.

The water which issues from any tidal basin such as that at Galveston or from any river, must struggle to reach the sea through the barricades of sand that are thus continually heaped up by the waves.

Now, as the influence of this action depends upon the height of the waves, it must follow that the deeper the mouth of the jetty channel is made, the less will be the ability of the waves to create a bar in front of that channel. I think it would be simply impossible that the waves of the Gulf of Mexico should disturb the sand in the bottom of the channel twenty-five or thirty feet at the end of the jetties. This opinion is based upon experience and observation at the jetties of the Mississippi River. Consequently, instead of there being a propriety in placing jetties two miles and a quarter apart at such a location as Galveston, through fear of an advance of the bar, it must be evident that they should be placed so as to create the deepest channel compatible with the safety of the jetties against being undermined, and with due regard to the economy of their maintenance. The closer together they are, within the limits of safety, the less will the friction of the bed retard the entry and exit of the water through them, the deeper will be the channel produced by the current, and the earlier will be the relief afforded to commerce. The deeper the channel the less possible will be the reformation of the bar in front of it. If they be placed too close together, the channel will become so deep that the jetties themselves will be undermined, or the cost of maintenance will be increased.

It must be evident to any engineer who takes up the study of a problem like this, that these gentlemen entirely overlooked the effect of both friction and wave action in the location of their works, and were totally wrong in anticipating an advance of the bar; nor did they consider the effect of wave action in determining the height of their jetties. In a space of two and a quarter miles wide, and but from twelve to fourteen feet deep, with a bottom of quicksand, disturbed by every storm which sweeps across it from one side or the other, the wave action would be sufficiently energetic to level down and obliterate any channel which the current in calmer weather might be able to excavate; but it will be presently seen that the height to which they limit the jetties, must expose any channel excavated between them to serious interruption, if not obliteration, by the sands which would be transported from the outside of them into the jetty channel. They propose that only a portion of their jetties shall be built up to the level of mean low water, thereby leaving the tide to rise from one to four feet over the tops of these portions even where they are highest.

The jetty system is essentially a system of conservation of the water and not one of diffusion. But, as if this facility of overflow were not a sufficient violation of the fundamental principle underlying the jetty system, they actually weave into their plan enormous outlets by which the lateral escape of the water through each jetty near the land will be made. (See plan of works in Colonel Mansfield's report of 1880.)

What is known on the Mississippi River as the *outlet system* has undergone the most crucial scientific discussion and careful study during the last eight or ten years. It has been condemned by the Mississippi River Commission, who were directed by Congress to examine and report upon it, and it has been also rejected by the action of several Congressional committees as a system wholly wrong in principle where the deepening of a channel is to be sought. Although this decision was arrived at four or five years ago the experimental plan of the Galveston jetties has continued, and the flood-tides, whose volume should be retained in their outflow to deepen the channel, are allowed to escape over the whole length of the submerged jetties.

The two jetties proposed by Capt. Eads and his associates, for the improvement of Galveston Harbor, will be about nine miles long each, extending into deep water and with crests built considerably above high tide; the distance apart is not stated, but they would be presumably something less than four thousand feet distant from each other. The estimated cost is $7,750,000, to be paid only as the channel is deepened; a system of payment similar to that adopted for the Southwest Pass of the Mississippi. He proposes a finished depth of channel of thirty feet, instead of the eighteen feet contemplated in the present plan.

Inspection and Testing of Iron Road Bridges in Germany.

According to a decree published some time since by the German Minister for Public Works, all iron bridges on public roads are to be subjected annually to rigorous inspection and tests. The parts to which special attention is to be directed in the inspection are:

1. The girder-beds and the brickwork of the piers and abutments. 2. The bed-plates with regard to normal position, freeing them from rust, etc., and eventually seeing that they are in perfect working order. 3. The riveting at the junctions of bracings, etc., with the booms, especially the existence of loose rivets at points where the greatest strain is borne. 4. The separate parts of the bridge; whether any fractures have occurred at the rivet holes, and whether bending, rust or want of paint is manifest. After the inspection of the bridge, it will be evident whether any measurements are required to be taken; if so, they are to be made with a view of ascertaining: (*a*) The normal height of the bearing-plates; (*b*) the height of the center of the bridge and its camber when unloaded; (*c*) the amount of oscillation produced by vehicles passing over the bridge.

If, after the above inspection and measurements have been made, the state of the bridge should be doubtful, load-tests are to be resorted to, in order to bring out more prominently any defects which may exist in the structure. For measuring the deflection a level is generally to be employed, but the use of other means and apparatus in suitable cases is allowed.

THE standard of weight in proportion to height which is recognized by most insurance companies as a basis for calculating expectancy gives a range of from 120 pounds for a man 5 feet 1 inch in height to 178 pounds for a man 6 feet in height. The ratio of increase is not uniform. A man 5 feet 6 inches, for instance, should weigh 145 pounds; one 5 feet 7 inches, 148 pounds; 5 feet 8 inches, 155 pounds; 5 feet 9 inches, 162 pounds, and so on up. The average weight of a healthy woman is about 20 pounds less than that of a healthy man. There may be and are variations from the figures I have given you even in health, but they are as near the average as can be ascertained.

Photo-Copying of Maps, etc. as Employed in the Ministry of the Public Works in France.

In the study of some projected public or private work, the original map or plan will frequently become covered with alternative routes, distinguished, perhaps by special colors. When a definite route or design is finally adopted the trial lines become useless, and should be removed.

The final drawing is generally a tracing made from the original and leaving out the abandoned lines. This tracing is made in India ink, if only one copy is required, or with crayon or autographic ink, if it is desired to transfer the drawing to stone or zinc for purposes of reproduction.

The use of tracing paper is troublesome, as any lack of transparency causes confusion in the more delicate details, and a certain mobility in its surface interferes with the exactitude of the copy. A photographic reproduction of the original plan, with all its lines reproduced is much more easily handled, provided that the useless lines can be made to disappear after the adopted line is traced in Indian ink upon this photographic copy.

We will first suppose that the original detail has been reproduced photographically, with or without modifications of scale, but always by a negative proof.

With this negative a positive image is made upon sensitized paper (but not albumenized), and without the gold bath, but simply fixed by hyposulphite of soda. After the usual washing, it is dried, and upon this exact reproduction of the original the draughtsman makes all the modifications required for the completed design.

If a single copy is required, India ink is used in tracing upon this photographic positive. But as this positive contains a photographic copy of all the other rejected lines as well, these must be made to disappear by plunging the sheet into a proper bath. The following are among the solutions used for this purpose:

Bichloride of copper.....	15 grammes.
Water.....	100 "

This will cause the image to rapidly disappear; the sheet is washed and then fixed by hyposulphite of soda for the purpose of dissolving the chloride of silver, which last would otherwise cause the image to reappear when it is exposed to the light. After it is again washed the hand-traced outline will alone appear, upon a sheet of white paper.

Bichloride of mercury is sometimes used, in the proportions of 3 parts of the salt to 100 parts of water; but this solution interferes with the fixing process; upon contact with hyposulphite of soda, ammonia, etc., the image immediately reappears.

A solution of 3 per cent. of cyanide of potassium rapidly bleaches the proof; but the action is almost instantaneous, if, to 5 per cent of this liquid just sufficient iodine is added to lightly color it. The image disappears in the last mixture, almost as soon as the sheet touches it, and as the excess of the cyanide of potassium dissolves the salts of silver formed, no further fixing is necessary. It is sufficient to wash it, and, provided that the India ink tracing is not rubbed the drawing will pass intact through all this manipulation.

If a number of copies are desired, the work of the draughtsman must be done in crayons or autographic ink so that it may be transferred to the stone or zinc. But to make this transfer the paper used should be especially sized, which is not the case with photographic paper; this sizing is done as follows:

The sheet is first covered with a sizing made of arrow-root starch, to which has been added one-fourth part of gum arabic and one-eighth part of sugar. After it is dried, the prepared side of the sheet is passed over a warm solution of gelatine, of 1 part to 10; it is then again dried and pressed and is ready for use.

If an impression in several colors is required a single photographic proof will still suffice. After making the first color transfer, the sizing is found to have disappeared together with the lines traced, which were merely on its surface; the sheet can now be re-sized and the tracing made for the second color, and this process continued until the series is completed. As the different colored lines are traced absolutely from the same sheet they must register exactly in the printing.—*Le Génie Civil.*

Things our Convention Reporter would Like to Know.

How our brother reporter of the Buffalo press would proceed, when he tells us that the best method of treating a "submerged weir" is to inject it with creosote, after first carefully removing the "air and sap?" The suggestion is new to hydraulic engineers, and its startling novelty recommends it, if nothing else does.

What have "Submerged Wires" to do with the hydraulics of Lowell? They would be a good thing under the streets of New York, but in this case "weirs" would read better.

What shape does that monster, the "*Teredathan Naralis*," usually assume, and how can it best be recognized? We were told, in one of the daily papers, that it was "a mollusc which eats into a discussion." This definition, while vague, is suggestive of terrible powers of penetration; that is, if it gets the best of some of the technical discussions which are now and then remorselessly fired at the engineers in annual convention.

What particular form of *hari-kari* was adopted by that misguided Buffalo reporter who gave all the details of a trip of the visiting engineers, when the trip itself was postponed on account of the Buffalo Rainfall.

What another fellow meant, when he announced, among the convention papers, "The Wear on Pius, from Observations on the New York Elevated Railway?" Did he refer to energetic expressions, in bad English, evoked by a "coal down the back" or "a cinder in the eye," or did the printer's devil invert an "n?" Either explanation will make the title good.

What became of that particular bottle of champagne, at the Society's reception, which, when our reporter left, had already vanquished five engineers and three waiters, in their vain efforts to extract the cork? It was early in the evening and their arms were, consequently, still possessed of vigor. It was noticed that all the cork-screws produced by the engineers, were of approved patterns and had apparently stood a "good duty-test," but in this case all previous experience and technical knowledge failed to overcome the "frictional head" in that particular "service pipe."

Whether the Sunday floral decoration of the Pittsford Church really did suffer by the advent, into that village, of the engineers and their lady-friends, or whether that excuse was "an invention of the enemy" to save some remnant of their flowers for the delectation of the villagers themselves?

Whether the good people of Pittsford were not a little *too* generous, when it came to the chunks of bread furnished, called sandwiches? The appetite of an American engineer is proverbially good, but there is a limit to all things, even to an engineer's mouth.

Whether the trip to the Tifft Farm was not a shrewd scheme on the part of the Improvement Company to use the American Society of Civil Engineers as an agents in the "transportation of material?" In any event a goodly portion of the surface soil was carried back to Buffalo on the boots of the members.

Whether those members, agriculturally inclined, were not a little disappointed in their inspection of the Tifft Farm Improvements," as set forth on the programme? They found coal-bins instead of granaries, and the soil upturned by dredgers instead of steam-plows.

Whether the mattresses used on this "Farm," to confine Lake Erie to its bed, were in any way suggested by the other mattresses which the Pennsylvania Dutchman uses to keep him in his bed? Switches are useful in both cases, but in Pennsylvania these are only employed to stir up the lazy young occupant.

And finally whether everybody, ladies included, did not think this was about "the best Convention ever held?" That is the usual verdict after each and every convention.

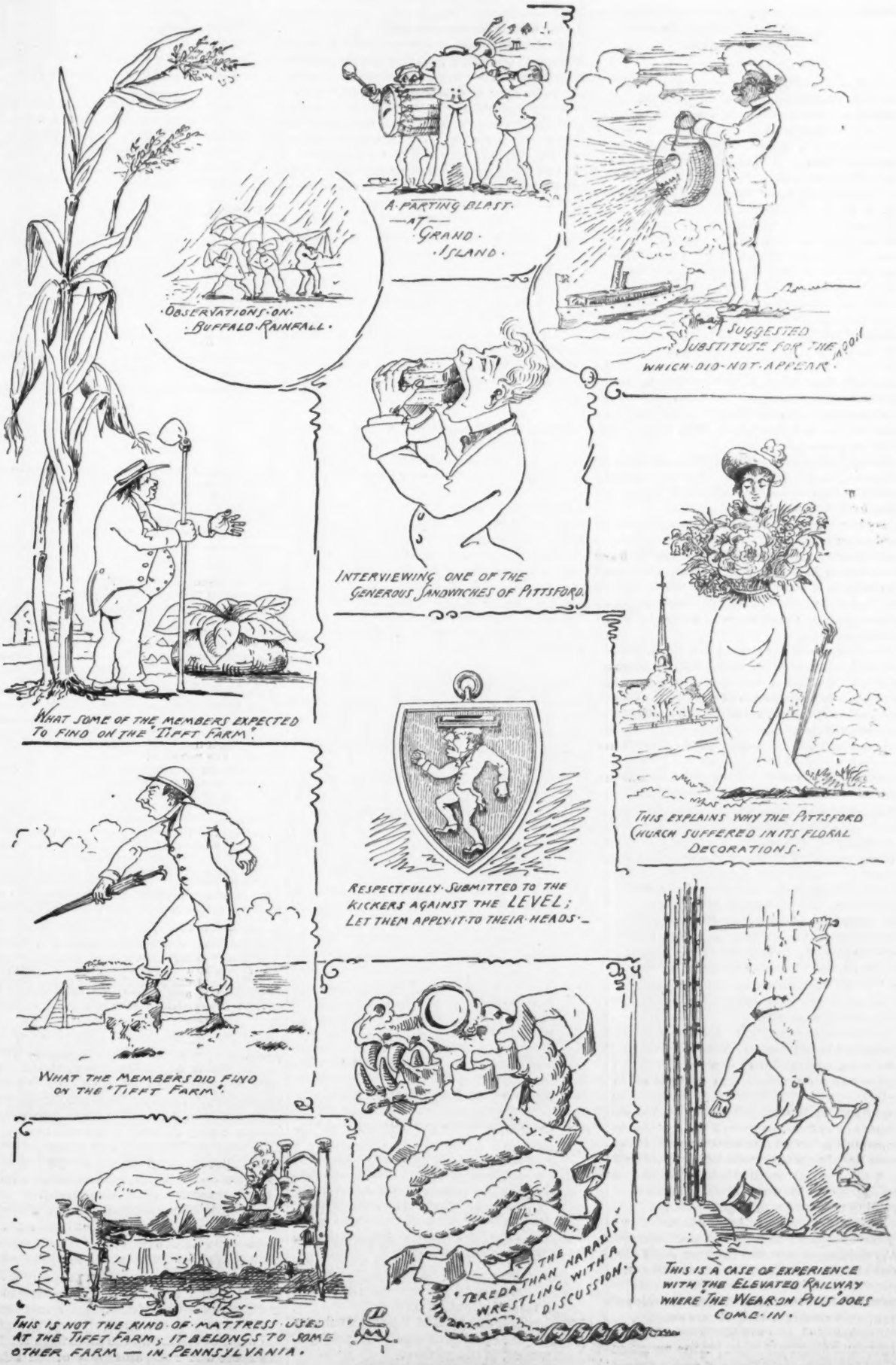
Government Contracts.

James D. Fish, President of the Marine bank, claims to have believed that Grant & Ward possessed large government contracts, out of which they made immense profits. The questions naturally arise, to what extent government contracts are profitable, and what government contracts are. It has been doubted that any well-informed business man could be made to believe that government contracts could become so profitable as to warrant the tying up of millions of dollars in them.

An officer belonging to the quartermaster's department, at the Army building, on Houston street, recently said: "No man at all conversant with business principles, certainly no man acquainted with the practices observed in awarding army contracts, could for a moment imagine that large government contracts can be secured in any but the regular way. To begin with, government supplies are contracted for by more than one department. Putting out of question stationery supplies for the various departments, food and forage supplies are required by the army, navy, and interior departments. The revenue marine also absorbs small quantities that are contracted for by the treasury department. Army and navy supplies are very similar. In the army, wearing apparel, forage supplies, furniture, housing, blankets, etc., are contracted for by the quartermaster's department. Food stuffs for officers and men are contracted for by the commissary department. Ordnance supplies are purchased by the ordnance department. The quartermaster's department attends to the transportation for its own and all other departments. Now, suppose that a certain number of bushels of oats, or tons of hay or coal, or so many dozens of blankets are required. The law directs that bids be invited, through publication in newspapers for thirty days prior to opening the bids. The bids are opened in public, and contracts are awarded to the lowest responsible bidders. Bonds are exacted in all cases. If the goods in quality and quantity do not come up to the requirements of the contracts, the bonds are proceeded against. The rules of the department are incompatible with large contracts, for supplies must in every instance when practicable be purchased in the locality of the post where they are to be consumed. It is desired by the government that residents at or near the posts should reap the benefit of contracts.

"This practice, too, makes great saving in transportation. You see, then, that no firm can purchase oats, for instance, in Chicago and ship them to remote and diverse quarters to fill army contracts. Do you suppose that Chicago markets can buy oats in California, Washington territory, or Kansas, and ship them back again to those points cheaper than they can be purchased there?

"Army contracts are for the most part small. Navy contracts are similar, and Indian contracts are subject to the same rules. Upon the arrival of supplies at posts the quartermaster institutes a rigid inspection for his own protection. Duplicates of all contract awards are sent to the departments at Washington. Of course the construction of ships and public buildings is a different branch, of which we know nothing, and in which none but experienced concerns experiment."—*New York Commercial Advertiser.*


A PARTING BLAST AT GRAND ISLAND.
OBSERVATIONS ON BUFFALO RAINFALL.
A SUGGESTED SUBSTITUTE FOR THE APOLLO WHICH DID NOT APPEAR.
INTERVIEWING ONE OF THE GENEROUS SANDWICHES OF PITTSFORD.
WHAT SOME OF THE MEMBERS EXPECTED TO FIND ON THE "TIFFT FARM."
THIS EXPLAINS WHY THE PITTSFORD CHURCH SUFFERED IN ITS FLORAL DECORATIONS.
RESPECTFULLY SUBMITTED TO THE KICKERS AGAINST THE LEVEL; LET THEM APPLY IT TO THEIR HEADS.
WHAT THE MEMBERS DID FIND ON THE "TIFFT FARM."
A. T. & S. F.
"TEREDA" THAN NARALIS WRESTLING WITH A DISCUSSION.
THIS IS A CASE OF EXPERIENCE WITH THE ELEVATED RAILWAY WHERE "THE WEAR ON PLUS" DOES COME IN.
THIS IS NOT THE KIND OF MATTRESS USED AT THE TIFFT FARM; IT BELONGS TO SOME OTHER FARM — IN PENNSYLVANIA.

Reminiscences of the 16th Annual Convention of the American Society of Civil Engineers.

Connecticut Surveyors and Civil Engineers.

June 18th.—Connecticut people gathered in Hartford to witness the ceremonies connected with the unveiling of the statue of their War Governor Buckingham.

The Connecticut Engineers' and Surveyors' Association took advantage of the favorable opportunity to hold a social meeting in the Council Chambers in the City Hall and the following members and visitors were present: B. H. Hull, Hydraulic Engineer, A. F. Spencer, C. E., Bridgeport; C. H. Bunce, City Engineer, L. W. Burt, C. E., Timothy Drake, C. E., H. W. Ayres, C. E., C. B. Ball, C. E., Hartford; Sylvanus Butler, C. E., New Haven; E. P. Auger, City Engineer, Middletown; D. S. Brinsmade, Engineer Housatonic Water Power Co., Birmingham; E. B. Jennings, City Engineer, and W. H. Richards, Supt. and Eng. of Water-works, New London; F. F. Weld, City Engineer, H. J. Kellogg, F. W. Whitlock, C. E., F. W. La Forge, C. E., Waterbury; Albert Harris, C. E., Robert Fenton, C. E., ——Taylor, C. E., Willimantic; J. M. McKenzie, C. E., Southington; R. D. Barnes, C. E., Bristol; C. E. Chandler, C. E., Norwich.

After a pleasant hour had been spent in making new, and renewing old acquaintances, the meeting was called to order and pleasantly addressed by the President.

Following this the company was welcomed to Hartford by Mr. Bunce, through whose courtesy the Society had the use of the finely located room for the day.

The Secretary presented to the Association, in behalf of J. A. Brand, Supt., a complete set of the reports of the Water Commissioners of Norwich, and in behalf of the author, Clarence Winthrop Bowen, of New York, a copy of the "Boundary Disputes of Connecticut."

Votes of thanks were passed for both these gentlemen, as also to Mr. Bunce for the use of the Council Chambers.

By request Mr. Bunce gave an account of his recent visit to Buffalo with the American Society of Civil Engineers.

E. B. Jennings, C. E., made an excellent address, full of encouragement to the younger members of this profession, which he said had until recently been scarcely acknowledged by laymen as a profession.

Quite a full expression of opinion was given by various members on the subject of the time and place of the next meeting, and about the middle of August as the time, and on the shore near New Haven as the place, seemed generally favored.

The company then broke ranks and from the windows of the room which overlooked the line of march on three sides, had an excellent view of the parade in honor of Connecticut's War Governor.

C. E. CHANDLER.

"Fudging."

"Fudging" is not a pretty word, considered simply as a word; but it is a royal beauty, etymologically considered, to what it is in actuality.

"Fudging" is the employment of a system of offsets got by "rule of thumb" or by "guess-work formulas," to set down a compound curve or other line, in preference to either following correct algebraical methods, or working of tables carefully constructed beforehand.

Avoiding the Scylla of algebra, the fudger runs into the Charybdis of botchwork.

Transit and chain ought to be good enough for any field-engineer; and eyework and fudging ought to rule their employer out of practice.

Books of formulas and tables are plenty enough, and accurate and cheap enough, to render any resort to fudging proper ground for instant and disgraceful dismissal. It is costing the railroad companies of this country tens of thousands of dollars a year to have fudgework straightened out.—*Journal of R. R. Appliances.*

FILTRATION OF WATER.*

BY H. W. ROGERS, LAWRENCE, MASS.

The writer after referring in a general manner to filters and their use and abuse, quoted from a Providence journal an article describing the cleaning of the Pawtucket filter-bed, which is 2 feet thick, made of stone running in size from "eggs to peas," and "with an area of only 460 square feet, capable of filtering 12,000,000 gallons per day." The reporter dilates at length upon the quantity and filthy quality of the discharge during the washing process.

Mr. Rogers directed attention to analyses by Prof. Edward S. Wood, of Harvard University, of water taken from a pond itself and this same water after it has passed the filter. The result showed that the filtered water was the most dangerous to health; that in this case, the filter being long uncleaned, the comparatively harmless pond water was leached through a "festering bed of fertilizers, called a filter, and thus poisoned delivered to the consumer.

The discussion of Mr. Roger's paper was opened by Wm. R. Billings of Taunton. He said there are filters and filters, some which may be good and some which are not to be approved. He would suggest a distinction which it would be well to make. Would it not be well to distinguish between filtration proper and mere straining? If the proportion of water which passes over a cubic foot of filter is very large is it not mere straining? He questioned whether results might not be obtained by slow filtering which would not be open to the criticism offered by Mr. Rogers.

Mr. George A. Ellis, of Springfield, said that Mr. Rogers had certainly presented his views in a very strong manner, but the speaker agreed with Mr. Billings that there are filters and filters. It has been demonstrated on the filter beds of Europe and at Poughkeepsie that not more than 6 feet should pass in an hour to be properly filtered. Rapidly running water does not come under the head of filtration. Advocates of filtration do not contend that the chemical properties of water are by it greatly changed. Decayed animal life and other substances cannot be taken out of water by ordinary filtering.

Edwin Darling of Pawtucket, R. I., explained the system of filtering water in that town, through the bottom of the reservoir, which is capable of frequent cleaning, by which a very clean and pure water is obtained.

Mr. Walker asked if anybody could tell why fish bothered them at Manchester from the last of March until June, when we have to go a-fishing, and at no other time.

Mr. Richards suggested that perhaps it was because the law was off.

Mr. Darling expressed himself as strongly in favor of meters, and distributed among the members printed copies of a paper read by him on the subject before the American Water-works Association at Cincinnati in April.

Steel *vs.* Iron Girders.

C. L. Strobel, C. E., of the Keystone Bridge Co., draws the following conclusions in a paper read before the 'Engineers' Society of Western Pennsylvania, entitled "Experiments on Steel and Iron Riveted Girders, and Remarks on the Tests Made by the Dutch Government:"

1. Each of the steel girders showed a large increase in strength over the iron girder; the soft steel girders proved 22 per cent. stronger, and the hard steel girders 66 per cent. stronger, than the iron girder.

2. The greater strength of the soft steel over the iron in the specimens was fully attained, and exceeded, in the girders.

3. The hard steel girders did not show so large percentage of greater strength over the iron girder as did this material in the specimen. This may be accounted as the result of punched holes which gave way by the fracture of the tension flange, whereas the girder with reamed holes gave way in the compression flange and probably would have stood more before fracture had taken place in tension flange. The latter girder did not appear to bear truly upon its supports, and it was probably this which caused it to fail in the top flange when it did.

4. Punching rivet-holes without reaming did not produce any result other than an apparent loss of strength, as compared with reamed holes.

5. The strength of steel girders strained in the manner of these girders appeared about the same for the two flanges if made alike in section.

* Read at Lowell, June 19, 1884.

Wrought Iron Tube for Cable Railways.

In view of the success attending the introduction of the cable railway in San Francisco and Chicago, there can scarcely be any doubt that it is the street railway system of the future, destined to supersede the present mode of propelling street cars by horse power, owing to its many advantages, such as greater speed, economy of motive power, and occupancy of much less space in the streets.

The engraving we present in this issue illustrates a new system of tube for cable railways.

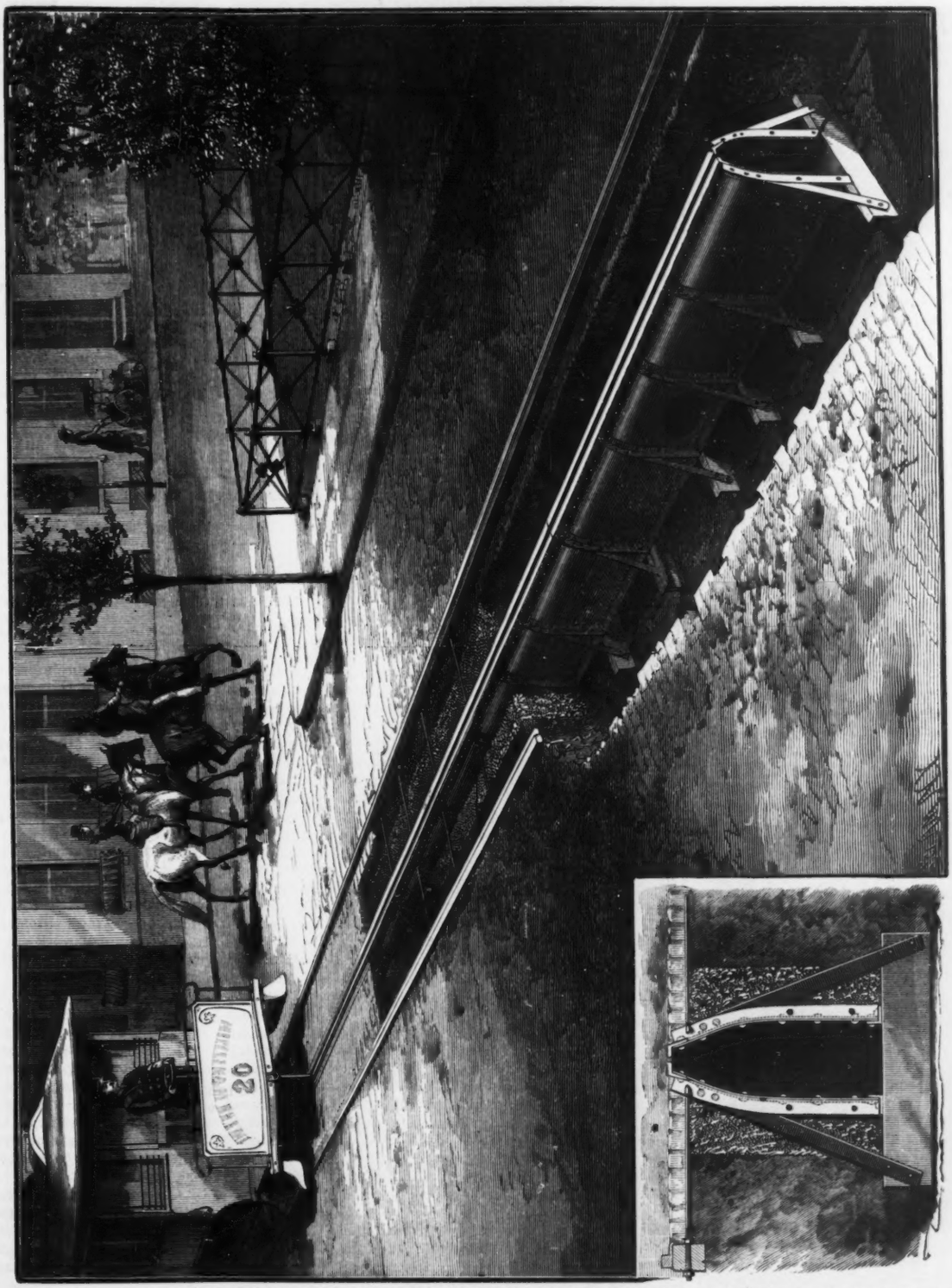
This tube is made up sections bolted together, each section being a self-contained girder, the upper chord of which has a continuous slot, admitting the grip bar to the interior of the cable tube. Each section consists of two opposite side plates, the upper portions of which are bent so as to converge toward each other. To their upper edges are riveted angle bars of proper shape, far enough apart to form the continuous slot above referred to. The lower edges of these side plates are connected with angle bars to a bottom plate. The side plates, and preferably also the bottom plate, and the top and bottom angles, extend throughout the entire length of the section, thus forming a self-contained girder, of which the upper angles form the top chord, the side plates, the webs, and the lower angles and bottom plate the bottom chord.

To provide against lateral pressure on the sides of the tube from the pavement and from vehicles crossing over the top chord angles, a series of braced frames are riveted to the sides and bottom of the tube, consisting of angle ribs, lower tansverse channel beams, or heavy angles, and inclined brace bars, riveted to the upper end of the angle ribs, and to the ends of the lower transverse channel beams or angles.

The body of the girder or tube is about 33 in. deep; the transverse channel beams are 8 in. deep. The clear width of the tube in its lower portion is 12 in., and the length of the transverse channel beams is 40 in.; being the widest part of the tube at any point. The sections are made in convenient lengths of about 16 ft., the connection between two consecutive sections being made by bolts through angle ribs at their ends. Thus a continuous tube or conduit is formed, complete in itself.

The work of laying the tubes is extremely simple. A trench is dug 3 feet deep from the surface and 3 feet 8 in. wide, for a distance of a block at a time, into which are lowered the tubes, and, after having been properly leveled up and bolted together and connected to the track stringers by three-quarter inch round rods attached to the angle ribs on the tubes, the work of closing up the ditch begins. First the space under and alongside of the tube is filled with concrete to within a foot of the surface of the street, sand to the depth of several

A NEW SYSTEM OF WROUGHT-IRON TUBE FOR CABLE RAILWAYS.



inches is then thrown on, and the whole paved over with Belgian blocks.

Every alternate tube is provided with a manhole in one of the web plates, affording access to the tube for the purpose of introducing or removing the cable, oiling the sheaves, etc. At each of these manholes a chamber is made in the concrete, accessible from the street through a square opening alongside the track, which is covered with a cast-iron lid.

It will be seen that the whole process of laying these tubes is so very simple, that the advantages of this system of tubes are quite apparent. The limited width of the trench, which leaves the tracks wholly intact, enables the construction of the cable railway to proceed without interfering with the running of the horse cars, requiring any temporary side tracks or movable bridges, where existing lines of horse railway are changed into cable railway. In this connection Mr. George Rice, Chief Engineer of the Cable Division of the Union Passenger Railway Company, of Philadelphia, which company is now completing the laying of 20 miles of this tube, writes in response to an inquiry:

"I have made a careful examination of the different cable roads in California and Chicago, and I believe our Philadelphia system of cable tubes is the best for several reasons. It is simple in its construction, and consequently cheaper than any of the existing systems of tubes that have any claim to permanency. These tubes can be laid more rapidly, and for construction on an existing line of horse railway, without interference with the traffic, this system has no rival.

"It would be impossible to build a cable line, such as is in use in Chicago or on Market Street, San Francisco, without side tracks or some device, such as a movable bridge, on which to pass the cars over the break in the street. In a narrow street the side tracks are not admissible, and the bridge device would be a cumbersome and expensive means of keeping the cars in motion over the work," etc.

Any further information in regard to the tube, relating to the construction, cost, etc., can be obtained on application to the inventor, A. Bonzano, Chief Engineer of the Phœnix Bridge Company, at Phœnixville, Pa. This system of tubes is patented in the United States and Great Britain.—*Scientific American.*

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AND

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Make all drafts, cheques and money orders payable to **Engineering News Publishing Co.**

WITH this number we close Volume XI. of ENGINEERING NEWS, and we will hereafter issue two half-yearly volumes with accompanying indexes. We have decided to do this upon the solicitation of numerous subscribers who felt the need of an index early in the year, and who consider that the yearly volume is growing sufficiently bulky to be divided. The new departure will probably find general favor, as it allows subscribers to bind in one or two volumes as they choose, and in the meantime is much more convenient.

A NEW volume marks a new starting point, a great convenience to a publisher whose "back numbers" are well thinned out and complete files impossible. We suggest to our subscribers that they complete the present volume at once as it will be quite out of the question after a while. We make no charge for such numbers of present volume as are missing, which we are able to supply.

WE are very much obliged for items of news relating to railroads, water-works, sewers, bridges, or any other engineering work, which may be sent us either as original correspondence, or by marked papers. We cannot very well place a money value upon such, but we are always pleased to reciprocate whenever occasion offers, such as in the purchase of books, or in the use of such advantages as our facilities afford us. Some items, though of local importance, are not of general interest, and may not be published. We are very much obliged, however, for the thoughtfulness of correspondents, and will be pleased to be reminded of back favors when our services are called upon.

WE are indebted to the firm of Root & Tinker, of the Tribune Building, for a copy of "Representative London Journalists," published by them. It is a large and beautifully executed lithograph, giving the portraits of eleven of the leading journalists of London, with their respective publications, in each case, used as a background. John Walter of the *Times* very properly occupies the central portion.

The sheet is a most excellent example of the possibilities of photo-lithography, the fac-simile of the letter-press of each journal being almost as interesting, from its clearness, as are the striking portraits of the several editors.

THE Pennsylvania Steel Company has lately issued a new trade catalogue giving carefully-drawn and full-size diagrams of the various patterns of rails manufactured by them. The diagrams range from the 66 lb. steel rail, used on the Penna. R. R. and other great trunk lines, to a 16 lb. rail for mining purposes. The dimensions, radii of curves and the angles are given with each rail section, and also the gross and net tons required per mile.

The various street-railway patterns are also included in this valuable exhibit of standard rail sections.

The Industrial Situation.

When the manufacturers' ledgers have been balanced for the half year, the result in the vast majority of cases will be found to be gratifying. Trade reports for six months past have been too full of gloomy predictions. Manufacturers, as a rule, give black accounts of trade conditions from week to week, not because business is being conducted at a loss, but because the profit in business is not as great as it was during the prosperous years of 1880-81-82-83. Last year the iron and all other industries began to feel the pinchings of the competition which grew out of the rapid expansion of our industries. This year restriction has been forced upon manufacturers in all channels of activity. Already the beneficial effects have been felt, and there are not a few in business who anticipate a decided improvement in demand, if not in price in September.

One cause of this favorable indication is the strength developed in commercial and manufacturing circles as the "squeeze" progresses. Another is the restriction of production which has been observed so widely. Surplus stocks are disappearing; meanwhile legitimate requirements are growing. The crops will be large. Money is plenty. Earnings of railroads and of manufacturing corporations continue good. Interests of all kinds are protected from a too severe competition by combination. All these facts are the foundation of the expected improvement which many hope will set in for fall. It is well to have confidence, but too much is worse than too little. It can be said that very little new railroad building will be undertaken this year, that there will be very few heavy requirements for material presented, that the country's capacity is more than equal to all the demand that will be brought before it, and that, therefore, prices will remain permanently low. Our last industrial boom came upon the country when its manufacturing resources were limited and its capital restricted. The next exceptional activity will come upon a country fully armed with facilities for the heaviest demand likely to be brought before it. It is idle to imagine that the era of booms, to use an expressive term is past. The material for more "booms" is in preparation. The consumptive capacity of the country and its inhabitants is expanding at an enormous rate of speed. Wages are advancing. The masses are demanding houses, lands, comforts, books, schoolhouses, churches, libraries, travel, in fact, the masses are becoming greater and greater consumers of the wealth they create. It is this fact that is not kept sufficiently in light. The column of domestic exchanges is destined to grow enormously, and the great market for our products in the future will be, not in Africa and Brazil, but at home, in the land of high prices, in the land of extravagant habits. There may be a year or two of comparative inactivity, but the elements are gathering for another rapid advance in production.

LITERATURE.

Transactions of the American Society of Civil Engineers April, 1884.

The paper of this number is "Experiments on the Strength of Wrought-Iron Struts," by James Christie. This is a detailed record of experiments made at the Pencoyd Iron Works, Pa., for the purpose of determining the comparative resistance to compression of long and short struts of rolled angle, tee, beam, and channel sections. The specimens were tested with flat ends, fixed ends, hinged ends, and round ends. The methods of fixing the test pieces is illustrated and the results given in tabular form.

Mechanic's and Engineer's Pocket-book of Tables, Rules, and Formulas pertaining to Mechanics, Mathematics, and Physics: including Areas, Squares, Cubes, and Roots, etc; Logarithms, Hydraulics, Hydrodynamics Steam and the Steam Engine, Naval Architecture, Masonry, Steam Vessels, Mills, etc; Orthography of technical Words and Terms, etc. etc. 45th Edition. by Chas. H. Haswell, Civil, Marine, and Mechanical Engineer, M. Am. Soc. C. E. Member of Eng's. Club of Phila. of the N. Y. Academy of Science, of the Institute of Naval Architects, England, etc. etc. New York, HARPER & Bros. Publishers, 1884. Price $4.00.

To say that the very comprehensive title really covers but a portion of the contents of this work, wonderful in the amount and variety of the information contained, is to give it but faint praise. The name of Mr. Haswell is familiar to a generation of engineers, and the author has made this pocket-book a life work, until, from the 284 pages of the first edition of 1843, it has spread over 922 pages in this last issue.

The present edition is a revision and complete reconstruction of the preceeding, and embraces over 250 pages of new matter, such as Masonry, Strength of Girders, Floor Beams, Logarithms, etc. All the illustrations are new and the type and presswork are unexceptional, as might be expected of any production from the press of the Harpers.

There is but one other pocket-book to which we can compare it, and that is Trautwine's. But the two works cover such widely different fields that they should stand side by side in the library of the engineer; united, they literally form a library of engineering knowledge in themselves. Each is original in conception and method of treatment, and while a portion of the contents is necessarily common to both, the engineer will benefit by the personality of these two engineering authors.

In addition to the vast amount of matter useful to the Civil and Mechanical Engineer, in his daily practice, Mr. Haswell has introduced a curious but most interesting collections of out-of the-way facts and informations, that must be appreciated, and render still more valuable this very valuable work. We mention a very few of those, to give some idea of their variety; weather-foretelling plants; treatment and antidotes to ordinary poisons; veterinary science; treatment of drowning persons; analysis of meat, fish, vegetables, etc. When we consider what a wanderer over the earth's surface, is the Civil Engineer, and how frequently he finds himself acting the part of a pioneer in human progress; the wisdom of Mr. Haswell is apparent, in giving, in a concise, portable form, just such information. The very existence of a party and the success of an expedition might at some time depend upon a knowledge of these apparently unimportant details.

This pocket-book must, in fact, be seen and

used before its full value can be appreciated; words alone can not describe it. We predict for it a wide circulation among engineers.

Wrought-Iron and Steel in Construction; Convenient Rules, Formulæ and Tables for the strength of wrought iron shapes, used as beams, struts, shafts etc., manufactured by the 'Pencoyd Iron Works. A & P. Roberts, & Co. JOHN WILEY & SONS, Publishers, New York.

This little volume, while nominally a trade publication, is really a most concise and useful treatise upon the application of wrought-iron and steel in construction.

It differs most materially from its predecessors in borrowing very little from the tables usually found in Engineers pocket-books, and substituting therefor, a fund of valuable original matter, the results of extensive personal investigation and test.

The tables of Pencoyd shapes are very full, and the behavior of wrought iron and mild steel, under tension, compression, shearing and torsion is fully set forth. The table of "Safe loads" upon beams, and the spacing and application of beams in floors, etc., are of exceeding usefulness. Other tables give graphically the bending moments and deflections for beams of uniform section; and elements of Pencoyd shapes. Formulæ are given for the moments of inertia in the various sections, and a table of the least radius of gyration follows; the last is especially compact and accessible for use.

The investigation of rolled iron and steel in struts is based upon several hundred carefully conducted experiments at Pencoyd, and together with the tables given, make a most valuable and unusual contribution to this class of literature. The tables are very full and reliable, giving the safe load in pounds per square inch, in length of struts from 4 ft. to 38 ft. for all the many shapes manufactured at these works; latticed channel struts are included in the tables.

From the reputation of Mr. Jas. Christie, of the Pencoyd works, as a pains-taking and conscientious investigator, we presume that he is the author of the original matter included in the present work; and we congratulate him and the Pencoyd Co., upon so useful a contribution to the workers in iron and steel.

Irrigation Engineering in the West—An Irrigating Canal.

Written for Engineering News.

BY C. A. MILLER, DENVER, COL.

During the past year the surveys and construction of irrigating canals in Colorado, and the neighboring territories, have afforded employment to nearly as many engineers as the railroads in the same country, and, excepting the railroads, more than any other enterprise.

Irrigation engineering in Colorado has now become a branch of the profession as separate and distinct as any we have, and its importance is continually growing. No books, and but few formulæ, can be carried into the field by the engineer in his location and construction work. Experience and the usage and custom of the older canal engineers determine the rules for the younger ones in the profession. Difficulties, almost as great as those met with by the railroad engineer, are encountered in this branch of the profession. Certain objects must be accomplished. Mountains are pierced, streams are crossed and turned from their old channels; dams, headgates and reservoirs built, and so forth. The engineer must determine the dimensions and grade of the canal in order to have sufficient capacity, in cubic feet per second, to irrigate the required amount of land. His judgment in economic location is often more exercised than that of the railroad engineer, while great care is also required of him in the construction. Accurate levelling is necessary and indispensable. The magnitude of the question, both for the engineer and the investor, can best be shown by a condensed description of an irrigating canal.

The Wyoming Development Co. is composed principally of wealthy cattle men of Wyoming Territory. The company have a tract of 60,000 acres of land, 80 miles north of Cheyenne. The company intend to colonize these lands. The lands are worthless for agricultural purposes without water. A plan upon which to construct a canal to irrigate these lands was decided on last summer, after many lines had been surveyed and abandoned. Construction has now been going on for about eight months.

A crib dam is built across the Big Laramie river, 25 miles from "Rock Creek" station on the U. P. R. R.; and the water turned in a canal nearly at right angles to the direction of the river on a grade $\frac{1}{10}$ to 100 ft. About 500 ft. from the river the water passes through a tunnel 3,100 ft. long with a grade of 2 ft. to the 100 ft., and a section of 7 wide by 8.5 high, including a sub grade of 0.5 ft. The corners of the section of tunnel are rounded out so as to cause as little friction as possible. Leaving the tunnel, the water from the Laramie joins with and follows down the course of the "Blue Grass," a small rapid mountain stream, and after 22 miles joins with the water of the Sybille river. About 3 miles below the confluence of the Blue Grass with the Sybille, the canal proper begins. Here a pile dam is built across the Sybille and a head-gate put in the mouth of the canal. The canal is 25 ft. wide on bottom, to carry water 5 ft. in depth, slope of cuts $\frac{1}{2}$ to 1 on upper side and 1 to 1 on lower (except in thorough cuts where it is 1 to 1 on both sides) and having a grade of 2.11 ft. per mile. Leaving Sybille, the canal follows along the foot of a range of hills and bluffs for 4.5 miles where it pierces the divide between the Sybille and a small creek, known as the "Dead Head." Reaching the latter stream, the water is carried across by a flume. Hence the canal follows down the said stream along its bluffs and hills, gains a bench, and after crossing several other streams and ranges, is brought to the lands to be watered.

From here laterals are taken out at intervals from the main canal as the land requires, and from the laterals, sub-laterals and again, sub-sub-laterals, traversing the land to be cultivated in such manner that the water can reach its every point.

The Sybille River and its natural tributaries have not the capacity in cubic feet per second to irrigate the amount of land required, hence the necessity of supplying the deficiency from the Big Laramie River, as has been described. One canal of the dimensions and grade above given, has not the capacity to irrigate land required, and consequently, another canal of the same dimensions is taken out of the Sybille 5 miles below the head gate of the first. The latter waters the lands on the lower side of the valley, and the first, on the upper side. The main canals proper, will be about 30 miles long, in charge of John S. Titcomb.

The tunnel is the most important feature of the whole plan of the canal. The material is a hard schist. The work is being done by compressed air drills which are kept running night and day. The time of completion of the tunnel will be about 9 months, of the canal lines about 4 months. The tunnel will cost about $50,000 and the canals lines about $250,000.

A discussion arose between the Engineer and the Superintendent of Construction, as to the most economic plan of building the tunnel. The superintendent holds that, on an uniform grade of 2 to the 100 ft., the velocity of the water will continually increase from the head of tunnel to its exit therefrom. As a consequence, if this hypothesis be correct, the water would not fill the tunnel up to its roof, but would leave a vacant space of a pyramidal form, running from a point near the head, and growing larger till it reaches the end. This vacant space would represent so much money expended for nothing. To counteract the effect of this increase of velocity he would increase the grade more at the head and diminish it towards the end, making a curved grade line, the sectional area remaining constant and total fall remaining the same.

The engineer maintains that the water will increase in velocity to a certain point in the tunnel, between 200 and 300 ft. from head thereof, from which point, owing to friction, its velocity will continue uniform to the end. He would, therefore, make the sectional area larger at the head, narrowing down to the original dimension at the point of uniform velocity, giving this part a funnel shape. Which plan is right?

No similar case, to the writer's knowledge, is on record, and if any of your subscribers can make any valuable suggestions or reference bearing this question through the columns of the NEWS it will be highly appreciated.

[In regard to the controversy as to grade, section and discharge of the tunnel in question, we can only say that further data is required before judgment can be passed. Both parties are right under certain conditions, but to present the case intelligently, a profile should be furnished, showing the total available head of water, between surface of water at entrance to, and discharge from the tunnel, and some idea given as to the condition of the walls of the tunnel, its roughness or approximate smoothness, alignment, etc. These elements are of especial importance in arriving at even an approximate co-efficient for friction; deduction of 50 or more per cent. may have to be made on this account from the usual formulae for the flow in pipes.—Ed. ENG. NEWS.]

New England Water Works Association.

The Third Annual Meeting of the above Association was held on Thursday and Friday of last week at Lowell, Mass.

The meeting was called to order by the President, Frank E. Hall of Quincy, Mass., and the first business was the election of the following members:

Active—Daniel Russell of Everett; John C. Chase of Wilmington, N. C.; Gilbert Murdock of St. John N. B.; Junius A. Brand of Norwich, Conn; A. H. Howland of Indian Orchard, Mass.; Marshall Masons of St. Albans.

Fine—H. R. Worthington of New York; B. S. Grush of Salem; R. D. Wood & Co., of Philadelphia; Marshall T. Davidson of Brooklyn. After the reading of a short address by the President, the roll of membership was called, the following responding to their names:

Active—Wm. R. Billings of Taunton; J. Henry Brown of Boston; Jonas M. Clark of Northampton, Mass; Robert C. P. Coggeshall of New Bedford; Edwin Darling of Pawtucket, R. I.; Nathaniel Dennett of Somerville, Mass.; George A. Ellis of Springfield, Mass.; Albert S. Glover of Newton; Robert M. Gow of Medford; Sherman E. Grannis of New Haven; Frank E. Hall of Worcester; Ward W. Hawkes of Malden; Thomas A. Hodge of North Adams; Horace G. Holden of Lowell; David W. Horan of Clinton, Mass; Horatio N. Hyde Jr. of Newton; Addison Lane of Melrose; Thomas C. Lovell of Fitchburg; Alvord O. Miles of East Providence, R. I.; Hiram Nevons of Cambridge; Albert F. Noyes of Newton; Walter H. Richards of New London, Conn; Henry W. Rogers of Lawrence; Joseph G. Tenney of Leominster, Mass; Charles K. Walker of Manchester, N. H.; William C. Wilcox of Waltham.

Fine—Chas. H. Baldwin of the Equitable Water Meter Co. of Boston; Jason Giles, manager of Chapman Valve Manufacturing Co. of Indian Orchard, Mass.; Jno. C. Kelley of the National Meter Co. of New York; B. Fiske of

the Union Water Meter Co. of Worcester; Wm. B. Sherman, Secretary of the Corliss Steam Engine Co., Providence, R. I.

The following newly elected members were also present: John C. Chase, Gilbert Murdock, A. H. Howland, Marshall Mason, H. R. Worthington, B. S. Grush and Junius A. Brand.

The present membership is 57—48 active and 9 "fine," an increase of 14 during the year. Two meetings of the association were held during the year, one at Worcester, Mass. and the other at Pawtucket, R. I.

The following are the officers for the ensuing year:

President.—Geo. A. Ellis, Springfield, Mass.
Vice-president.—Charles K. Walker of Manchester, N. H.; Horace G. Holden of Lowell; Alvord O. Miles of East Providence, R. I.; Nathaniel I. Jordan of Auburn, Me.; Walter H. Richards of New London, Conn.
Secretary.—Albert S. Glover, Newton, Mass.
Treasurer.—Edwin Darling of Pawtucket, Rhode Island.
Executive Committee.—Henry W. Rogers of Lawrence; Sherman E. Granniss of New Haven; Frank E. Hall of Quincy. Mass.
Finance Committee.—Hiram Nevons of Combridge; Thomas C. Lovell of Fitchburg, and J. Henry Brown of Boston.

William B. Sherman of Providence made an interesting address to the convention, and suggested that the plan be adopted of each member preparing a sketch of some work which had come under his direction and presenting it at the next meeting in order that the whole association might have the benefit of each member's experience. He presented a sketch 20 by 15 in. to serve as an illustration of his meaning. It would be expedient that all sketches should be of uniform size. If at the next annual meeting each member should bring a sufficient number of copies of some sketch to be distributed among the other members, all would find themselves in possession of more valuable information than could be obtained from all the engineering books that might be written. Mr. Sherman said that he made the suggestion in order that the association might make a beginning in disseminating each other's experiences. His remarks were received with applause, and were coincided in by Messrs. Billings, Coggeshall, all of whom agreed to bring one or more sketches at the next meeting.

Miscellaneous matters were then considered, and the executive committee were authorized to make arrangements for the co-operation of the association with the American Association at the annual meeting of the latter in Boston, April 15, 1885.

Henry W. Rogers of Lawrence related his experience with iron gate boxes, but could not say that he would from an economical standpoint, recommend their adoption by others. Thomas A. Hodge of North Adams and Horatio N. Hyde, jr. of Newton, related their experiences with various gate boxes.

It was voted that the plan presented by Mr. Sherman, be adopted by the executive committee and that the secretary be instructed to notify absent members.

At 2 o'clock a grand banquet was given to the association in the spacious dining room of the St. Charles by the Lowell water board and the members of the special committee appointed by the city council. Of the members of the committee there were present Alderman Crowley and Councilmen Hogan, Peirce, Wilson, Sparks and Chadwick. Seats having been taken at the tables, the company was called to order by Col. A. A. Haggett, president of the water-board and chairman of the committee on arrangements, who announced that in the absence of the mayor he would extend a warm welcome to the association in behalf of the city of Lowell. A few moments later Mayor Donovan appeared and was introduced. In a brief speech he said that it gave him great pleasure to welcome the convention to the queen city of the Merrimack valley. The question of a water supply was an important one and had always engaged the attention of thoughtful citizens and municipalities. He trusted that the business deliberations of the association would be productive of much good. An hour was then spent in discussing the choice viands on the menu and the members again proceeded to the parlor for the afternoon session.

The afternoon session was called to order at 3 o'clock, when C. B. Fitz of Attleboro and Lucian A. Taylor and George E. Batchelder, both of Worcester, were chosen active members of the association.

W. H. Richards of New London, Conn., then read a paper on "Service Pipes, Material, etc.," which we publish in full elsewhere.

H. W. Rogers of Lawrence next read an interesting paper on "Filtration of Water," an abstract of which we also publish.

At the suggestion of Mr. Sherman it was voted that each representative present send to the secretary the size of water pipe used in their respective cities and towns, and any other interesting facts appertaining thereto, in order that they may be incorporated in the next annual report.

Carriages were then taken at 5 P. M. at the hotel door, and the members of the association, with the Lowell water board and the special committee of the city council, paid a visit of inspection to the pumping station, reservoirs and filtering galleries, all the visitors expressing great pleasure at the courtesies extended to them.

At the evening Session Mr. Coggeshall, the retiring secretary, declined to accept any compensation whatever for his service.

A committee of two, consisting of Messrs. Billings and Coggeshall, was appointed to suggest some plan at the next annual meeting whereby uniformity of reports of superintendents of water-works might be obtained.

A vote of thanks was extended to the Lowell City Government, the Lowell Water-board, Superintendent Holden of the Water-works, and to all others, for courtesies extended.

President-elect Ellis of Springfield invited the Association to hold its next annual meeting in that city, and his invitation was accepted.

After considerable discussion the arrangements for holding the fall field meeting were left in the hands of the executive committee with full power to name the place and fix the time.

On the morning of the 20th the members of the association were conveyed in three large barges from the St. Charles Hotel to the South Common, arriving there at 9.30, where they inspected the Lowell Fire Department, which was out in its entirety, machines and men. This inspection lasted but a few minutes, when the party left for the works of the United States Cartridge Oompany, where they made a short inspection, after which an extended drive was taken through Belvidere. The company then proceeded to the mills of the Middlesex Company, where they stayed a little while looking about the works. They were then taken in barges to the Pinafore landing which they left at 12 o'clock to spend the afternoon at Tyng's Island.

About 100 invitations had been sent out to persons other than members, including the mayor, members of the city government, school board, city officials, heads of departments, and others. The party which numbered nearly 200, arrived at the island at one o'clock. Dinner was served at two o'clock in the Island House by the proprietor, John H. Brown. It was a most excellent spread, to which full justice was done by the hungry water-works superintendents and invited guests. Col. Haggett presided at the banquet, and, after making a brief speech, presented Mr. Chickering of Providence with two presents as appropriate souvenirs of the association's meeting just held in this city. Mr. Chickering responded in a happy manner. Speeches were then made by Mayor Donovan, President-elect Ellis of Springfield, and Messrs. Fiske of Melrose, Billings of Taunton, Moulton of the Lowell *Citizen*, Harrington of the Lowell *Sun*, and Darling of Pawtucket, R. I. After dinner the time was occupied with the various amusements which the island affords. There was a game of base ball between a nine of which alderman Fletcher was captain and another captained by alderman Donohoe. Ex-alderman Garity was umpire and ex-alderman Phillips was scorer. At 5 o'clock the party took the boat for Lowell, arriving at the wharf about 6 o'clock. Most of the members of the association immediately left the city for their homes, all expressing in the highest terms their thanks for the numerous courtesies which had been extended to them during their stay. Credit is due the committee on arrangements for the very successful outcome of the convention.

SERVICE PIPES.*

BY W. H. RICHARDS, SUPT. WATER WORKS, NEW LONDON, CONNECTICUT.

Probably in no other particular in the designing of systems of water supply have so many errors been made as in fixing the size and selecting the material for service pipe. And very little has been written regarding this subject. An inferior service pipe is often adopted from motives of economy or in deference to a popular wish, or it may happen that in the hurry of completion of the works the matter is overlooked, the attention of the engineers or managers being taken up for the time with more important matters, and the plan adopted in haste is continued. The importance of a properly constructed service pipe can be appreciated when we consider that a large portion of the annual expenditures in most cities, other than those for extension of mains, is for service pipes or connected with them. By way of preface it should be clearly understood that the following remarks apply to an ordinary service pipe only, i. e., a pipe laid from the main across, or partly across, the street to the building to be supplied; this pipe to be kept constantly full of water under pressure.

Among the qualities desirable in a service pipe the following are perhaps the most prominent: 1st. It should be free from anything likely to render the water passing through it unhealthful or discolored. 2d. It should be so durable that once laid the trouble and expense of repairs and renewal will be reduced to a minimum. 3d. It should admit of being laid with reasonable speed and cheapness. 4th. It should be so constructed as to deliver the greatest quantity of water for a given size. The first mentioned quality is paramount, and the second should never be sacrificed through motives of economy. While there can be no economy in using a pipe not of the most lasting nature, this may be outweighed by the fact that with certain waters the most durable pipe may be unhealthful; but where possible the service pipe should be laid in the most permanent manner, thereby subjecting the public to as little inconvenience as possible and preserving the uniformity of the street covering, and grade. This is especially desirable where the street is paved or macadamized.

Up to the present time the only materials extensively used for service pipe have been lead, either used alone or lined with tin and wrought-iron with or without some coating or lining. Of the wrought-iron pipes the following are mentioned in Croes' Statistical Tables as now in use: Wrought-iron without coating or plain, galvanized, tarred, enameled, and cement-lined. There have been several other

*Read at the Lowell, Mass., Meeting of the New England Water-works Association, June 19th, 1884.

coatings and linings used, as tin lined and rubber coated, but they have proved unsatisfactory for various reasons, and their merits need not be discussed in this paper. Plain wrought-iron is used to a limited extent, but with ordinary waters is soon filled with rust. While the rust is not detrimental to health it unfits the water for laundry use, unless the water is filtered after passing through it. Some waters act on exposed iron with much greater rapidity than others, but there can be little doubt that with all waters a service pipe of the smaller size would clog in a few years. In New London, ½-inch pipes were completely filled in two years. While ¼-inch of rust would seriously obstruct a small pipe, it would be of less consequence in the larger sizes, so that for large pipes a material may be used that should not be thought of for the ordinary size of service pipes. Most coated wrought-iron pipes, from the writer's experience, are open to the serious objection that, while the coating may be proof against corrosion, the ends of the pipe were cut (as they must necessarily be in practice), and the interior of the fittings are more or less exposed to the direct action of the water, and the rust accumulates in the couplings, elbows, T's and other fittings, causing an obstruction, while the interior of the pipe itself may remain clear. The brass cocks and fittings used on iron pipes seem also to have an affinity for iron rust and are often completely obstructed.

Galvanized, or zinc coated iron, has probably been more extensively used than any other coated pipe, and is, perhaps, with the exception of cement lined, the best of the coated wrought-iron pipes. It is made by placing the plain iron pipe in a bath of acid to clean the iron, after which it is dipped in melted zinc. This forms a coating which is often imperfect, and where perfect will corrode so as to obstruct the pipe, the time required varying with different waters. Prof. W. R. Nichols, in his valuable work on "Water Supply," says: "When the pipes are exposed to the action of water, corrosion begins at once; at first the action is on the zinc alone, provided the original iron was free from rust and the treatment with zinc thorough; but after a time the zinc which remains will cease to protect the iron, and iron rust will begin to form. As regards this action it is simply a question of time." A ½-inch pipe will clog in from five to fifteen years and with exceptional waters may last longer. Its use has recently been abandoned in Middletown, Conn., after fifteen years' trial; while it has been used in Hartford about twenty-five years, although mention is made of stoppages by rust in the report of 1875. In New London, ¼-inch of rust was formed in three years. As regards its effect on health, while it is unqualifiedly condemned by some chemists, it is endorsed by others. It is probable that it is more dangerous than lead, but with ordinary waters may be harmless when used as a service pipe of ordinary length and always kept filled with water.

Tar-coated iron is prepared by a process, which the manufacturers keep to themselves, with a coating probably of tar and asphalt. It is but little used as a service pipe and is open to the objection made to similar pipes.

Enamelled iron has recently been adopted by a few cities as a service pipe. The coating or enamel, which is patented, is applied at a high temperature. It is pronounced by good authority to contain no deleterious substance, to be durable, elastic, and to fully protect the iron from corrosion. This pipe seems to be open to the objection before mentioned, i. e., a want of protection at the joints where the pipe is cut. Although a liquid enamel is sold with which the exposed ends and the fittings may be coated, as it is impracticable to apply it with heat, the pipe itself is being coated, it is likely to prove but a temporary protection. With some better device for protecting the joint this pipe would seem likely to prove a good one.

Cement-lined pipe has been used in several cities and towns principally in New England, for the last twenty years, and may be said to be no longer an experiment. The process of lining the wrought-iron pipe with cement is familiar to many of you, but for the benefit of those unacquainted with it I will briefly describe the process adopted in New London. The sizes used are ¾ inch, 1 inch and 1¼ inches in the clear. Portland cement was at first used for the lining, but after experiment a small proportion of Rosendale mixed with it was found to work better. The cement after being properly mixed, is injected into the pipe with a press made for the purpose, after which two cones of the diameter of the finished bore, are drawn through, pressing the cement against the sides. After lining, the pipes are carefully laid one side until the cement is set, when a liquid grout is poured through to fill any interstices there may be in the first coat. This process will make a ¾ inch pipe of a 1 inch plain iron pipe at an expense of about two cents per foot. Cement-pipe is often laid with plain iron, galvanized or brass fittings, but none of these serve to protect the end of the pipe. There are two ways in which this object may be accomplished in a measure. One, as practised in Worcester, is to fill the plain iron couplings with cement as the pipe is laid, and after making up the coupling, drawing through a rubber cone previously inserted in the pipe. This process which requires that the cement be given time to set before the water is let on, may be quickened by the use of a quick-setting cement, but it is impracticable where joints are made with elbows or T's. The other process as practised in New London is to line the fittings with tin containing two brass ferrules of the same bore as the pipe; the ferrules projecting over the end and protecting the exposed iron. As regards health, cement-lined pipe is all that could be desired. In the writer's opinion it is, next to lead, the best pipe for service pipe and can be used where the nature of the water or popular prejudice would not admit of the use of lead.

Of the pipes other than wrought-iron there is tin-lined lead and plain lead. Tin-lined lead is a lead pipe coated on the interior with a very thin coating of tin. While the coating undoubtedly protects the lead in the pipe proper there is a great liability of exposure at the joints, especially where made on to fittings, from the melting of the tin lining while wiping the joint. Where the lead is so exposed this pipe possesses no material advantage over lead pipe, as the action of water on lead, in contact with another metal is said to be more rapid than on lead alone. In the writer's opinion, and in the opinion of higher authority, there is also a chemical or galvanic action between the two metals tending to destroy one or the other. The above objection and its high price would seem to counterbalance any advantage it may have over lead. This pipe has been used to some extent in New York City and in Providence. In the latter city it was abandoned for lead after a short trial.

Lead pipe has been in use since 1236, and since that time has been subject to infinite trials and tests as to its effect on water. It has been used, and is in use to-day in all the principal cities of Europe and has been adopted and used as a service pipe in over 50 per cent. of the cities of 20,000 or more inhabitants in this country. Lead pipe, while a little more expensive as to first cost than wrought-iron pipe, is more easily laid and much more durable. In a rocky or uneven trench, while lead can be bent or curved around obstructions, the wrought-iron must be laid nearly straight. It thus reduces the cost of trenching. Lead can also be laid in one continuous length thus avoiding joints with their attendant danger of obstruction.

There has long been a prejudice against lead pipe, especially in the smaller cities and towns, owing to the popular idea that the water dissolved the lead and a dangerous cumulative poison was taken into the system with drinking water that had passed through it. This, no doubt, arose from the practice of taking water from wells and springs, through lead pipes sometimes several hundred feet long, and of drawing rain water from lead-lined tanks and cisterns through lead pipes. Under these circumstances there is no doubt of the danger of using lead pipe, but under the conditions mentioned at the beginning of this paper, where the pipe is constantly full of water, rarely still 12 hours at a time, the danger is reduced to a minimum except perhaps with some waters of a peculiar chemical nature. Prof. W. R. Nichols, a very high authority, in a complete article published in the *Sanitary Engineer* of December, 1883; says: "As a rule, with waters suited for water supply, there is next to no danger in the use of lead service pipes." Reports favorable to its use were made by the Cochituate water board; after extensive experiments, in 1848, its use was advised by a commission appointed by the British Parliament, and it has been recommended by numerous commissions and engineers since. Although lead has been in use for many years in all large cities, the cases of lead poisoning are very rare and when occurring, the cause can be traced to extreme lengths of pipe, a lead tank or fixtures other than the service pipe, where the lead is exposed alternately to air and water. But before adopting lead as a service pipe it is best to test the pipe under the same condition in which it will be used, when a protecting coating, of the compounds of lead, will usually be found to have formed on the interior of the pipe. Where wrought-iron service pipes are in use they are generally, and should always be connected to the main with a short piece of lead pipe to allow for contraction or settlement, and an examination of this piece will show the protecting coating. Prof. Nichols, in the article before referred to, says that with the Boston water the coating was brown on the outside from the presence of organic matter, and underneath this coating was a layer of carbonate of lead. This brown coating has been noticed in several other cities.

In order to decide the relative cost of the different kinds of pipe we will compare the cost of ¾ inch service pipes, 25 feet long with ½ inch corporation cock and ¾ inch curb cock, omitting labor, freight, cartage, stop-box and paving, the cost of which will vary in different places. The basis being the market prices of February, 1884. Taking the cost of a lead service pipe as above, weighing three and one half pounds to the foot, at 100 per cent., the other kind will cost as follows: Tin-lined lead 190, enamelled iron 65, cement-lined iron 58, galvanized 50½, tarred 49, and plain iron 46. But as the cost of trenching and back filling is generally less for lead and about the same for the others, the relative cost of the service pipes complete, is more favorable to lead. Take, for instance, two service pipes 25 feet long laid complete, one to be of 3½ pound lead and one of galvanized iron. The cost of the lead service will be, say $12 and the galvanized, say $9.00. Suppose the galvanized pipe lasts fifteen years, after which time it must be relaid. The cost of relaying will be, say $5.50 (provided the brass cocks are not damaged), which, added to the first cost is $14.50. After allowing interest on the orginal difference in cost, the galvanized has cost more than the lead. Owing to the smoothness of the interior surface, lead and tin-lined lead pipe possess a larger discharging capacity than the iron pipes. From hurried experiments by the writer it was found that, while under fifty pounds pressure, a ¾ inch cement-lined pipe, 50 feet long with 3 elbows, delivered but 21.7 gallons per minute, a lead pipe, under the same

conditions, delivered 24.6 gallons per minute, or about 13 per cent. more. The discharge from the cement-lined pipe in this instance was retarded by imperfect tin-lined elbows, and it is probable that the difference would ordinarily be eight to ten per cent., and where the elbows are of brass or unlined, perhaps less.

It would seem from the above that lead pipe was the most economical as to cost, at least in the smaller sizes (possibly excepting cement lined), delivers the most water with a given size, and except with waters of an unusual nature is not detrimental to health. It is also more easily laid and requires fewer and less expensive tools, and no more skill to lay and connect it with the main. The ordinary wrought iron pipe is strong enough to withstand the usual range of pressure, but a lead pipe is made of so many different thicknesses, its weight can be proportioned to the size and pressure.

The scope of this paper admits of only a brief discussion of the thickness required for lead pipe. By a table given in Fanning's Treatise on Water Supply, the tenacity of lead is stated to be 2,386 pounds per square inch, and by a formula in the same work, which allows 100 pounds for water ram and a factor of safety of 4, a ¾-inch pipe weighing 3½ pounds to the foot, could be used under a pressure of 138 pounds, and one weighing 3 pounds to the foot under a pressure of 101 pounds. From experiments made for the Leroy Shot & Lead Co., the bursting pressure of the above weights and sizes was found to be 1,225 pounds and 1,072 pounds, and with the above allowance the safe working pressure would be 104 and 78 pounds, indicating a tenacity of 2,040 pounds per square inch. This would seem to indicate that it was safe to use a ¾-inch pipe weighing 3 pounds to the square foot under a pressure of 75 pounds, which is lighter than the general use for that pressure. It is probable that the tenacity of the ordinary lead pipe metal is below 2,000 pounds to the square inch. While it is best to err on the safe side, a great deal of money may be saved by carefully proportioning the thickness to the pressure.

In order to get the greatest quantity of water from a service of a given size all the fittings should be of the full bore of the pipe and all cocks round way. The inner surfaces should be as smooth as possible, and the radius of the bends as great as the circumference will admit of. When iron pipe is used an advantage might be gained by using elbows of a greater radius than those in common use. But the care used in proportioning the service pipe may be partially lost by bad work inside the building supplied. By using a service pipe one size larger than the tap, the discharge is largely increased, a ¾-inch pipe of the ordinary length, with ½-inch tap, delivering about 50 per cent. more water than a ½-inch pipe with the same tap, and but about 10 per cent. less than a ¾-inch pipe with a ¾-inch tap. In the above example about $1 can be saved by reducing the discharge 10 per cent.

Nothing is more usual than for applicants for water to insist on a much larger service pipe than is necessary. Without so reducing the size as to inconvenience the consumer the time in which a given quantity is drawn should be prolonged as much as possible, particularly where large quantities are used. If an establishment requires 1,000 gallons daily, it reduces the pressure on the mains much more to draw it in ten minutes than though the draft were prolonged through several hours, and the service pipe can often be so proportioned as to make this sudden draft impossible, although it is not always practicable to do so. The difference in pressure and the different requirements demand that the size of the service pipes be left with the superintendent or engineer to determine, but in general we may say that eight gallons a minute is a reasonable quantity for a small dwelling with one family, and this quantity can be drawn through a ½ inch tap and ¾-inch service pipe with 35 pounds pressure and over. The published tables of the discharge of service pipes should be used as a guide only as an allowance must be made for the friction on bends, fitting, &c. A table showing the discharge of service pipes as usually laid would be very useful.

The rule of using the best material, holds good with stop-cocks, gates and other attachments to a service pipe as well as with the pipe itself. There is no economy in using inferior fixtures of any kind. It is the practice in some cities to do without a curb stop, and when it is necessary to shut off the water to enforce a rule or make repairs it is necessary to dig up the street over the corporation cock. A stop inside the curb stone, covered with a cast-iron box with lock cover obviates this and soon pays for itself.

The back filling of the trench should be thoroughly done so as to avoid after-settlement. It has been the writer's practice to have the back filling tamped from near the bottom to the surface with a tamper weighing about fifteen pounds, and this was found to be more effective in most soils than back filling with water. Where the back filling is thoroughly tamped there should be no settlement of the paving.

In the above remarks I have endeavored to discuss the subject of service pipe from a business standpoint. Much more could be said regarding the strength and discharge of service pipes which I trust we may soon see embodied in a paper by some more competent member of this association.

At its conclusion a short discussion upon the paper followed.

Charles K. Walker, of Manchester. inquired if anybody had been troubled with cement-lined pipe filling up with rust.

Mr. Richards said he never had the pipes fill up, but the couplings often did, which amounts to the same thing.

Mr. Hall stated that in an experience of seventeen years, he had never seen pipes fill up, though he had seen rust at joinings cause obstruction. Where the cement makes one continuous lining he had never been troubled. He had never been much troubled with cement breaking off, because great care was taken in transporting the pipe.

Mr. Addison Lane, of Melrose, said that after using cement-lined pipe three or four years, the enamelled pipe was put in. When using the cement-lined, not only the fittings, but the pipes all the way through were full of sediment, compelling the laying of new pipe. The enamelled pipe had given perfect satisfaction. He thought that, with the exception of lead, it is the best pipe in use. It was much better than any iron pipe.

Secretary Coggeshall said he was a firm believer in lead pipe for service. Since 1873, nothing but lead pipe had been used in New Bedford. He exhibited a section of lead pipe, laid in 1879, which he dug up last April. It was perfectly clean and as sound as when laid.

Mr. Lane said the enamel is liable to pull off after an enamelled pipe has been taken out, but not while in use. It will, in time, gather rust. It is not perfect, but it is the best of iron pipes in use. He believed that for the Melrose water, however, lead pipes would be more economical.

Mr. William R. Billings, of Taunton, said that cement-lined pipes were used in that city, and there had been no occasion to take up service pipes because of obstructions. Had taken up pipes to examine their condition. Found the lining worn off near the points. Since then has lined the couplings by hand and has experienced no trouble with them. We use enamelled fittings altogether. As they are never cut there is no danger of breaking the enamel. There is no question but what lead is the best service pipe. The question is, what is the next best?

Mr. Horace G. Holden, superintendent of the Lowell Water-works, had several pieces of lead pipe to show, some of which had been laid 12 years. The pieces were all smooth inside, and in good condition at joints and the fittings were also in good order. Superintendent Holden strongly favors lead service pipes.

Mr. William B. Sherman suggested that each member furnish the data giving diameters and weights per lineal foot and corresponding heads for pipes used in his practice, the same to appear in the printed annual proceedings as an appendix to the paper just read. This was thought by the chair to be a very good suggestion, and it was voted to act in accordance therewith.

CORRESPONDENCE.

The Seekonk River Bridge.

Special Correspondence Engineering News.

PROVIDENCE, R. I., June 24, 1884.

EDITOR ENGINEERING NEWS.—I enclose herewith an abstract of bids received on June 21st for the superstructure of the Seekonk River Bridge.

Very truly yours,
JOSEPH P. COTTON.
Commissioner and Engineer.

Cofrode & Saylor, Phila. Pa.,	-	4.90 cts. per lb.
R. F. Hawkins, Springfield, Mass.	-	5½ " " "
Passaic Rolling Mills, Paterson, N. J.	-	4.54 " " "
Boston Bridge Co., Boston, Mass.	-	4.34 " " "
Cooper Hewitt & Co., New York.	-	4.85 " " "
Riverside Bridge Co., Paterson, N. J.	-	5.22 " " "
Penn Bridge Co. Beaver Falls, Pa.	-	5.20 " " "
Phœnix Bridge Co. Phœnixville, Pa.	-	4.45 " " "
Iron City Bridge Co., Pittsburgh, Pa.	-	4.87 " " "
Keystone Bridge Co., Pittsburgh, Pa.	-	5.00 " " "
Union Bridge Co., New York,	-	4.95 " " "
Shiffler Bridge Co.,	-	5.00 " " "
Canton Bridge Co., Canton, O.	-	5.30 " " "
King Bridge Co., Cleveland, O.	-	5⅛ " " "
J. R. Smith, Springfield, Mass.	-	6⅛ " " "
Jones & Benner, Phila.	-	5.15 " " "
Edge Moor Iron Works.	-	5.14 " " "

The contract was awarded to the Boston Bridge Co.

THE HISTORY AND STATISTICS OF AMERICAN WATER-WORKS.

BY J. JAMES R. CROES, M. AM. SOC. C. E. : M. INST. C. E.

(*Continued from page* 317)

DCLVI. FREYBURG, ME.

Fryeburg, Oxford Co., Maine, in lat. 44° N., long. 71° W., is on a level sandy plain with outlying granite hills from 100 to 1,000 ft. in height.

Settled in 1763, it has never been incorporated.

Water-works were built in 1882 by a private company after plans of D. L. Lamson, and under the superintendence of A. R. Jenness, the supply being taken from a mountain stream having a water-shed of 800 acres, across which a dam of granite masonry laid in cement is constructed, forming a reservoir 3 miles distant from, and 155 ft. above the village. The water is conducted to the village by 10 and 6 in. cast-iron pipes and is then distributed by 4 miles of cast-iron pipe of 6 to 3 in. diameter with 17 fire-hydrant, 8 gates, and 160 taps. One meter is in use. Service pipes are of tarred wrought-iron. The daily consumption in 1883 was 10,000 gallons. The population in 1880 was 88, it is now said to be 650. The village does not pay for fire service. The capital stock of the company is $16,000, there is no bonded debt. The works have cost $17,000. Eben Weeks is President, and D. Lowell Lamson Secretary of the company.

DCLVII. FARMINGTON, N. H.

Farmington, Stafford Co., New Hampshire, in lat. 43° 20' N., long. 71° 6' W., is on irregular ground on Cocheco River.

It was incorporated as a town in 1798.

Water-works were built by the town in 1871, the supply being taken from springs and be-

ing pumped by a Blake steam pump to a reservoir 80 ft. above the town.

Distribution is by cement and iron pipe of 8 to 4 in. diameter with 12 fire hydrants and 4 gates. Service pipes are of iron. No further information is given. The population in 1880 was 3,040.

E. Williams is Chief Engineer, and Chas. W. Talkey, Clerk.

DCLVIII. CORSICANA, TEX.

Corsicana, Texas, in lat. 32° N., long. 96° 20' W., is on rolling prairie land.

Settled in 1847 it was incorporated a city about 1871.

Water-works were built by a private company in 1884; after plans of G. C. Heron, taking the supply from springs. The water is collected in a reservoir having a capacity of 3,000,000 gallons, and pumped thence by two Worthington steam pumps, having each a daily capacity of 750,000 gallons, into a stand pipe 20 ft. in diameter and 100 ft. high which stands on a hill having an elevation of 40 ft. above the surrounding country.

Distribution is by 5 miles of galvanized iron pipe of 10 to 4 in. diameter, with 87 fire hydrants for which the town pays $4,000 per year. Service pipe is of galvanized iron.

The population in 1880 was 3,373, it is now said to be 6,000.

The capital stock of the company $80,000. The Works have cost $95,000. There is no bonded debt. W. T. Brown is President, and B. T. Bany, Secretary.

WATER.

DEL RIO, Tex., is to have new water-works.

SAN ANGELO, Tex. is to have new water-works.

THE city council of Centreville, Md., will erect water-works.

THE City Councils of Pensacola, Fla., are discussing the subject of erecting water works.

THE city councils of Franklin Tenn., will build water-works.

WORKS are to be erected by the Sweetwater Water-works Co., at Sweetwater, Tenn

H. B. FOLK, of Brownsville, Tenn., is at the head of a concern which proposes to build a gas-works for Trenton, Tenn.

MR. W. T. G. SNYDER, of Bellefontaine, Ohio, has been awarded the contract for constructing the reservoir for the water-works in Lexington, Ky., and has arrived and will begin the work at once.

THE Town engineer and the Superintendent of water-works in Lake View, Ill., favor putting in a new 20-inch inlet pipe, and an additional pump with a capacity of 4,000,000 gallons daily. The estimate for these improvements is $30,000.

AT the recent special meeting of the Evanston, Ill., village trustees, measures were considered for the improvement of the water-works. There is much trouble at present from sand which finds its way into the pipes. The committee on water has the matter under consideration.

AT the last Annual Meeting of the Massachusetts State Firemens' Association, one of the topics for discussion was," The Merits and Demerits of the Holly System of Water-works" and it was unanimously voted that the Holly system has merits worthy the attention of this convention."

THE Pond Engineering Co., St. Louis have been awarded the contract to furnish the Pumping machinery for the Lexington, Mo. Water Works, which will consist of two Blake Pumping Engines, each having a capacity of 1,500,000 gallons per day. One will be a compound duplex condensing engine for continuous service. The other will be a non-compound duplex engine for reserve, with boiler feed pump, heater, etc., complete. These engines will be required to work against a fire pressure of 140 pounds.

ANOTHER Watertown Mass. water meeting will be held Monday evening, June 30th. The Watertown Water Supply Co., recently chartered by the Legislature, will submit a proposition for introducing a water supply, and will ask the town to take hydrant service at the rate of $6,000 per annum for 125 hydrants. The Selectmen, as required by law, have approved the making of a contract with this company, and now it will be necessary for the town to instruct the Selectmen to make the contract. It now appears as if the end to the great struggle which has agitated the town for twelve years past is drawing nigh.

RUSSIAN WATER-WORKS.—Nicholas Simin, Chief Engineer of the Moscow (Russia) Water-works, has addressed a letter to "the municipality of the City of Detroit," stating the City of Moscow proposes to built new water-works, and he thinks the modern constructions of this kind in the United States the most instructive and conformable to his conditions. He sends a list of printed questions asking the capacity per day of the Detroit works, kind and length of pipes, description of the engines, the influence of water-works on fire protection, and other questions of the same kind.

AT the Annual Meeting of the Stock holders of the Alliance Water-Works Company, held in New York, on June 2d, the following gentlemen were unanimously elected Trustees for the ensuing year, *viz.*: J. A. Cloud, Danl. Runkle, R. E. Brewster, J. Jay Pardee, and E. C. Hine. At a meeting of the Trustees held the same day the Board organized by electing the following officers, *viz.*: President, J. A. Cloud, Vice President, R. E. Brewster, Secretary and Treasurer, J. Jay Pardee. The works of the Co. are at Alliance, Ohio, have been in operation six months, and are considered the Banner Works of the Western Reserve.

J. D. COOK, of Toledo, O., the well known hydraulic Engineer, has patented a means of cleaning reservoirs without drawing off the water. The bottom is divided into a number of hopper-shaped receptacles about 30 ft. square, each provided with gates and pipes at the lowest point. These out-let pipes are connected with one or more main discharge pipes; when the percentage of sedimentary matter is high the gates are opened to such an extent that there is a constant flow of the muddy water. The sides of the hoppers are inclined at such an angle that the sediment will slide down to the lowest point.

UTICA, N. Y., June 22.—The tax-payers of the Village of Clinton voted Saturday on a proposition to authorize the construction of a system of water-works, the estimated cost of which is $30,000. Especial interest in the matter was caused by the determined opposition of Judge Theodore W. Dwight, of New York, who owns much property in Clinton. He issued an address to the citizens, urging that the improvement is not needed that its cost will reach, if it does not exceed, $70,000, and place a burden on property which will drive away investors and residents. Thirty women offered their votes against the proposition, 15 of which were refused because the names of those offering them are not on the assessment roll. Mr. Dwight insisted that, as the women are tax-payers, their votes should be received, and sharply denounced A. W. Mills, President of the village and Acting Inspector of Election, for refusing to receive them. The vote resulted in a majority of 75 for water-works out of a total of 293. The victors got out the village band, and, leading a large procession marched through the town and serenaded President Mills, the Trustees, and other citizens who had favored the improvement. The works proposed will be adequate for a village of 9,000 indabitants.

THE plans and specificatiens for the water-inlet crib at the Hyde Park tunnel have been adopted by the Hyde Park trustees, and work on the construction will be commenced as soon as a bid has been accepted which will probably be done Saturday. The tunnel has now been completed to a distance of over four thousand feet from the lake shore at the foot of Sixty-eighth street. During the last few days the contractors have again encountered "good" ground, and satisfactory progress is being made at the face of the tunnel.

Although the village has in its employ four civil engineers, a consulting engineer, engineer of public works, and two assistants, complaint is made over the action of the trustees in employing an "outside" man to draw up plans, and paying therefor the sum of $500. The consulting engineer of the village had previously submitted a series of plans and specifications which were recommended for approval by G. M. Pullman and a dozen or more of the heaviest property-owners of the village. Nevertheless, the plans of W. S. Smith were adopted, and bids for the work will be opened Saturday. The inlet crib will be located one mile from shore in twenty-six feet of water. Providing no accident happens, the tunnel and crib will be completed about Sept. 1st.—*Chicago Times.*

AT a meeting of the Dallas, Tex. City Council on the 17th the following communications were received relative to furnishing the city with water.

"Honorable Mayor and Board of Aldermen—Gentlemen: The undersigned and associates desire to submit a proposition to your honorable body for the introduction of a water supply for the city, and hope to have the same ready to submit in a very few days, and would respectfully ask that no definite action be taken until our offer is before you, which will be in a very few days and at the earliest possible moment that we can get our plans and figures made up. Yours very respectfully,

W. C. Connor."

"To the Honorable Mayor and City Council of the City of Dallas—Gentlemen: We, the undersigned, will furnish you with a good supply of from 1,000,000 to 4,000,000 gallons daily of wholesome water, delivered at your pumping works, at Browder springs, for the sum of $12,000 per annum, payable as follows: Six thousand dollars as soon as your committee receives the works, and $3,000 at the end of each quarter afterward, and should you desire at any time to purchase the works we will sell the same to you for the sum of $100,000, and we will agree and bind ourselves to keep the supply up at all times, and all machinery, pipes, etc., used in bringing the water to the place of delivery in perfect order until your purchase. Should you accept this proposition we can commence work within two months and complete the same within twelve months from the acceptance of this proposition. Respectfully,

ED. D. CHAPIN AND ASSOCIATES."

Both communications were referred to the water committee.

NEWS OF THE WEEK.

Railroads and Canals.

WORK on the Mexican International Railway is to be resumed at once and pushed through until completed to Victoria, Mex.

A CORPS of engineers is surveying a route for a railroad between Wytheville, Va., and Lexington, Ky. Frank G. Ruffin, Jr., is in charge of the survey.

CINCINNATI, June 22.—The Trustees of the Cincinnati and Southern Railroad have under consideration the changing of the gauge of the road from the Southern gauge of 5 ft. to the standard gauge of 4 ft. 8½ in.

OF ninety-six railroads in the State of New York only fifteen paid dividends in 1883. The total capital stock of the railroads is $628,718,596, and the total amount of dividends paid was $15,974,114, or about 2 per cent. of the capital. Farm property presents a favorable contrast to such a showing.

THE Madison County Court, at a special session, has rescinded the county's subscription of $250,000 to the Kentucky Central Railroad Company for which consideration the Kentucky Central folks were to construct a railroad from Richmond to the Three Forks of the Kentucky River, in Lee County.

PINE BLUFF AND SWAN LAKE.—Incorporated in Arkansas to build a road from Rob Roy, Jefferson county, on the Texas & St. Louis, southeast to Swan Lake, Arkansas county, a distance of twelve miles. The capital stock is $120,000, and the incorporators and directors are: C. M. Neel, M. L. Bell, T. F. Burks, C. M. Neel, Jr., and A. A. Neel, all of Pine Bluff.

OTTAWA, ONT., June 18—A cablegram was received from Finance Minister Tilly this evening, announcing the successful floating of the £5,000,000 Canadian loan to-day at two and six pence over a fixed minimum rate of 91 bearing interest at 3½ per cent. The tenders were $3,000,000 in excess of the amount called for. This is the most successful loan Canada has ever floated.

SURVEYS on the projected Columbus and Memphis railroad will be commenced this week. A number of new railroads are contemplated in Alabama in addition to the above road, and some are now in course of construction. On the extension of the Georgia Pacific railroad the contractors have commenced excavating the tunnel eight miles from Boalberg.

INDIANAPOLIS, June 30.—The Columbus, Fort Wayne and Chicago Railroad Company filed articles of incorporation to-day. It has a capital stock of $4,000,000, and was formed to build a railroad through Allen, DeKalb, Noble, Kosciusko, Lagrange, Elkhart, Marshall, St. Joseph and Laporte counties, a distance of 125 miles. The directors are J. R. Sharp, E. C. Winstanley, B. F. Martz, John W. Ogden, A. A. Purman, O. M. Simons and P. A. Randall.

WORK is progressing very rapidly on that part of the Indiana, Alabama and Texas railroad that runs out of Clarksville, Tenn., and it is believed that the road will be completed to Princeton, Ky., by October next, says the *Nashville American*. Some twelve miles of it is already finished, and the section of country in which the road is now being graded is quite level and the grading will be pushed forward more rapidly than was possible through the hilly country through which it has just been built.

SOUTH-WESTERN, ARKANSAS & INDIAN TERRITORY.—Incorporated in Arkansas with a capital stock of $1,400,000 to build a road 150 miles in length from Warren, Bradley county, through the counties of Calhoun, Dallas and Clark, via Okalona, in the last named county, and then through Pike, Howard and Polk counties to the line of the Indian territory in latitude 34½ degrees north. The following compose the first board of directors: J. A. Smith, Gurdon; F. B. Vandorn, Smithton; J. S. Ross and J. J. Young, Okalona and S. C. Martin, Little Rock.

ST. LOUIS, IOWA & DAKOTA.—Incorporated in Iowa to build a road from a point in Appanoose or Wayne counties, thence northwes-

terly through the counties of Appanoose, Wayne, Monroe, Lucas, Clarke, Warren, Madison, Adair, Guthrie, Audubon, Carroll, Greene, Calhoun, Sac, Ida, Buena Vista, Cherokee, Clay, O'Brien, Sioux, Lyon and Osceola, and to the northern boundary of the State of Iowa. Capital stock, $10,000,000. The principal place of business will be at Chariton, with a branch office at New York City.

URBANA, OHIO, June 19.—The engineering corps of the Columbus, Fort Wayne and Western Railroad reached Fort Wayne yesterday about noon. Colonel Andrews chief engineer, and his assistants, W. E. Woods, E. G. Chapman, T. G. Keller and Isaac Happersett, junior, returned to this city this morning, where they will make a profile map and estimate of the work. They report the line a good and practicable one, and the people along the route are very much interested and anxious for the road to be built. There seems to be no doubt now that the road will be built in the near future.

RICHMOND AND CHESAPEAKE RAILROAD.—At the last session of the General Assembly a charter was granted to some of the leading citizens of Richmond, Va. to build a railroad from that city to the mouth of the Potomac River, crossing Pamunky at Hanover Town, the Mattaponi at Aylett's and the Rappahannock at Tappahannock, connecting with the Maryland Central road at Point Lookout by steam ferries. A meeting has been held and the railroad organized by the election of the following officers: C. E. Belvin, President *pro tem.*; S. G., Tinsley, Secretary and Treasurer; H. A. Atkinson, Attorney; A. L. Johnston, Chief Engineer. Directors, J. B. Pace, S. G. Tinsley, C. E. Belvin, H. N. Price, T. C. Leake, Jr.

CHATTANOOGA, Tenn. June 24.—A meeting has been called for Saturday, June 28th, to take action in the matter of building a railroad from this city to Anniston, Ala. The road will pass through Lafayette and Summersville, Ga. Galesville and Gadsden, Ala., to Anniston. The sum of $750,000 has already been subscribed for the purpose and agreements have already been made with persons who will take the contracts and $500,000 of stock. J. C. Vance of this city, formerly of Urbana, Ohio, will be President of the new organization, with J. W. James as Secretary. It is proposed at the meeting to take steps for immediate action. Steps are also being taken in Alabama to complete a road from Opelika, in that State, to Anniston.

EADS'S SHIP RAILWAY.—The new models of the carriage and pontoons of the Eads ship railway have started for London. Nearly all the capital for the enterprise is being subscribed in that city. Chief Engineer Corthell says 100 men are at work and that the first half mile of track has been completed. This, with the river course, which admits three of the largest ships abreast, completes 25½ miles of the Tehuantepec route. The new pontoon system of raising vessels from the water upon the railway carriage is to be substituted for the hydrulic system first contemplated. It was conceived by London engineers and adopted by Eads, and will raise a ship out of water and upon the carriage in twenty minutes

ARGENTINE REPUBLIC.—A correspondent of the Two Republics contribute the following valuable list of new projects in this country: Trans-Andine, Contractor Clark, kilometres, 1,280. From Buenos Ayres to Chili, via Mendoza, to cost $30,000,000 gold. This road has guarantees and subventions from the Argantine and Chilian governments. Buenos Ayres to Rosario. Kilometres, 296, Grantee, Mr. Billinghurst. Construction on this road has not yet commenced. Parana to Conception. Kilometres, 248. This road will cross the province of Entre Rios from the Parana river in Uruguay. Tucuman to Jujug and Salto. Kilometres, 360. This road will cost $10,000,000, and is building by the government. Rosario to Candalana. Kilometres, 50. Contractor, Mr. Casados. Azul to Bahia Blanca. Kilometres, 340. Contractors, Hume Brothers. Estimated cost, $7,000,000. Now constructing. Corrientes to Mercedes. Kilometres, 224. Work not commenced. To cost $6,500,000. Concordia to Gualaguazchu. Kilometres, 160. Work going on. Road to Cost $4,000,000. The most important of these lines in construction are the Andine, from Mendoza to San Juan and the extensions from Tucuman to Jujug and Salto, and the Western and Southern of Buenos Ayres.

COL. C. S. MURRY, the gentlemanly ticket agent of the Pennsylvania Railroad Company at Columbus, has in his possession two very old relics. One is a piece of the first line of telegraph wire used by the Pennsylvania railroad. It is about one-fourth as thick as the wire now in use, and is not covered, the bare brass or copper being exposed. The other relic is a copy of the Pennsylvania Railroad Passenger and Freight Schedule, issued January 1, 1850. It is about 8 inches long and 5 wide. At that time but three trains were run daily, two passenger, a through and way train, and one freight train. The Pennsylvania Railroad extended from Dillerville to Neyton, above Harrisburg, a distance of 109 miles. Mr. Herman Haupt was superintendent at that time. The following explains the running of the trains:

"Eastward through train must run to schedule time; all others keep out of the way. Wood train must keep out of the way of all others. Westward freight trains run on Tuesday, Thursday and Saturday. Eastward freight trains run on Monday, Wednesday and Friday."

The above relics can be seen at the ticket office of the Pennsylvania Railroad Company at Columbia, Pa.—Lancaster *New Era*.

FITCHBURG RAILROAD.—When the Fitchburg assumed the control of the Vermont and Massachusetts a few years since there was only a single track between Fitchburg and Greenfield, while at the present time a gap 2½ miles long between Orange and Wendell is all that remains to double track between Boston and the easterly bank of the Connecticut River. There are about three miles of single track between the Connecticut River and Greenfield, leaving only 5½ miles of single track between Boston and Greenfield. During the past year the second track has been laid from Miller's Falls to Wendell, a distance of 8 miles, and from Montague to the Connecticut River about 2 miles. About 2½ miles of second track between Wendell and Erving was opened last Wednesday. Considerable progress has been made in preparing for the second track where it is not yet laid, all the ledges having been excavated and considerable progress made in building new bridges, the most extensive of which is the new one now being constructed across the Connecticut River.

The entire length of the bridge will be 640 ft. divided into two shore spans of 50 ft. each and three spans of 180 ft. each. The approaches to the bridge will be improved by placing it at a different angle with the river than the old bridge. The westerly end of the bridge will be about 60 ft. south of the old bridge, but the easterly end will be about 130 ft. south of the old one. The grade of the track approaching the bridge will be improved by placing the new bridge 12 ft. above the level of the old one. When the new bridge is finished the old one will be removed and the material used at other points on the road. This is one of the largest bridge building enterprises that has been attempted in New England, and more than a year will probably be required to complete it.

Contracting Miscellany.

J. C. BRADFORD will erect a $32,000 iron bridge at Nashville, Tenn.

J. F. HANSON, of Macon, Ga., is negotiating for the construction of a street railway in that city.

THE Elyton Land Co. will construct a street railway at Birmingham, Ala.

A BRIDGE is to be built over the French Broad River, at Alexandria, N. C.

A. H. ROBISON is at the head of a company to build a street railway in Nashville, Tenn.

THE city councils of Calvert, Tex., will construct a $25,000 bridge across the Brazos River.

CAPT. W. A. LITTLE, with others, has applied for a charter to build a railroad from Columbus to Albany Ga.

THE Louisiana Central Railroad Co. will build a railroad from Lafayette Springs, La., to Baton Rouge.

BENJ. T. PERKINS, of Elkton, Ky., has charge of a railroad enterprise which is to be undertaken at that point.

THE city clerk of Birmingham, Ala., can give information as to the erection of six iron bridges at that point.

A NEW railroad is to be constructed from Gainsville to Newtonville, Ala., to be called the Warrior Coal Fields Railroad.

THE city councils of Columbus, Tex., are preparing to build a $20,000 iron bridge over the Colorado River.

AN iron bridge is to be built over the French Broad River at Asheville, N. C., by Messrs. Lyman and Roberts.

A RAILROAD, 130 miles long, is to be built from Apalachicola, Fla., to some point in Alabama, by the Apalachicola & Alabama R. R. Co.

A RAILROAD is to be built from Jessop, Ga., to Savannah, under the management of the East Tenn., Va. & Ga. R. R. Co., headquarters Knoxville.

WAPAKONETA, June 20.—The contract for building the Wapakoneta and St. Mary's pike was sold by the commissioners to-day to Arthur Bitler for $22,000. Auglaize street, on the pike, will be widened to 66 ft. to the Fair Grounds, making a magnificent avenue.

A CONTRACT for extending the Wood River Branch, Oregon Short Line, from Hailey to Ketchum, Idaho, was awarded June 15, to the Utah Contracting Co. Distance twelve miles. Trains will be running within sixty days,

FROM New Orleans to the city of Mexico, via El Paso, it is 2,423 miles; from St. Louis it is 2,573 miles; from Chicago it is 2,874 miles; from Washington it is 3,408 miles, and from San Francisco here it is 2,499.

WACO, Tex., June 20.—The school committee of the City Council met to-day and adopted plans for the ward school buildings soon to be erected. The plans contemplate the construction of brick buildings, 35 × 50 ft. and two stories high, at a cost of $10,000 each.

DALLAS, Tex., June 20.—Contractors of this city have been awarded the contract for building two iron bridges across the Bosque, one at Meridian and one at Clifton, to cost upward of $25,000.

THE National Sewer Construction Co. has filed a certificate of incorporation at Washington, D. C. Its term is ten years, and capital stock $100,000 of $100 shares. The trustees are Ammie A. Thomas, J. Ross Howard, W. J. Acker and E. C. Manning.

THERE are no less than 1,346 co-operative societies in England, with a membership of 661,000 persons. The yearly sales reach upward of $130,000,000, while the profits exceed $10,000,000.

FORT WORTH, Tex., June 20.—The City Council was in session to-day, and granted right of way to several street railway companies over the streets of Fort Worth, the most important of which was one traversing the principal part of the city and leading to the Gulf, Colorado and Santa Fe depot.

A committee reported in favor of a high school building to cost $75,000. The report was received and filled.

SINALOA, Mexico, from its proximity to the United States has begun to feel the impetus of new life. The introduction of modern mining machinery has already worked a revolution in the mining industry and the future output of ores promises to far exceed the past record of the State. The mineral riches of Sinaloa consist chiefly in gold and silver, though copper and lead deposits abound. The State contains forty-seven known mineral districts with 406 mines opened.

Paper Car Wheels.

The paper of a paper car wheel is nothing more nor less than ordinary straw-board. That made wholly of rye straw is preferable, The boards are cut into discs, and holes in the center are punched large enough to fit the iron axle shoulder that constitutes the hub of the wheel. Thus shaped, the straw boards are placed one upon another with ordinary flour paste, till a pile of them about five inches in height is attained. They are then put under a hydraulic press and squeezed together as tightly as it is practicable to compress matter of the consistency of straw-board. The pressure is so great as to generate many degrees of heat in the compressed board. After being thoroughly dried, the paper wheel is turned on a lathe to fit the heavy steel tire and shell into which it is inserted to form the core of the wheel. It is held firmly in its position by an iron plate the size of the inner surface of the wheel, and likewise by bolts. And in short, the paper of a paper car-wheel is simply a core or filling in a shell of steel, the outer rim or tire that runs on the track being nearly two inches thick. The virtue of the paper consists in the fact that it gives elasticity to the wheel. The durability of the paper wheel, on account of this elasticity, is computed to be many thousands of miles greater than that of the ordinary iron wheel.